Migrants, Income and the Environment: the Case of Rural Ghana

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Migrants, Income and the Environment:
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VRIJE UNIVERSITEIT

Migrants, Income and the Environment:
the Case of Rural Ghana

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad Doctor aan
de Vrije Universiteit Amsterdam,
op gezag van de rector magnificus
prof.dr. L.M. Bouter,
in het openbaar te verdedigen
ten overstaan van de promotiecommissie
van de faculteit der Economische Wetenschappen en Bedrijfskunde
op vrijdag 13 april 2007 om 13.45 uur
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De Boelelaan 1105

door

Victor Owusu

geboren te Obuasi, Ghana

promotor: prof.dr. J.W. Gunning
copromotor: dr. C.P.J. Burger

Preface

Writing this PhD thesis has taught me two valuable lessons. First, it is God who empowers us for success. I am indeed grateful to Him for guarding my thoughts and giving me strength to complete this project successfully within the stipulated period. The second is the resolve to use relentless effort, hard work and perseverance to overcome obstacles that tend to stagnate and impede the realisation of one's ambitions and goals in life.

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Several institutions and individuals have also contributed to the fruition of this thesis. Special mention must be made of the Netherlands Organisation for Scientific Research (NWO) which provided the bulk of the financial support. I also acknowledge the additional financial assistance from the Amsterdam Institute for International Development (AIID). At the very inception of the project, I benefited from the technical expertise of Tom Dietz (UvA, CERES and AIID) and Ruerd Ruben (Wageningen University and Mansholt Institute). Time spent in the thesis-writing was divided between Ghana and the Netherlands. Barbara Spruit of the Finance and Personnel Department of Free University of Amsterdam (VU) made sure that all my travelling documents were accurate. I am highly indebted to her. I also appreciate the untiring efforts by the Administration Staff of Amsterdam Business and Economic Research (AMBER-VU). Hanneke, Francine, Martin and Marga in particular, facilitated my travelling arrangements in-and-out of Amsterdam, provided logistic support and solved many of my financial problems.

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Contents

Chapter 1

Introduction

1.1. Background and Problem Statement

Large numbers of people migrate within and across the boundaries of Ghana. The migration patterns have significant economic and social impact on the development of the migrants and their place of origin and destination. Although rural-urban migration has been increasing in Ghana (Twumasi-Ankrah, 1995), rural-rural migration is also relevant. Rural-rural migration accounted for about 60 percent of the internal migration flows before Ghana's independence in 1957 to the 1960s (Batse, 1991). Rural migrant farmers during the period moved to the cocoa and food growing areas of Ashanti, Brong Ahafo, Western, Central and Volta Regions of Ghana in search of land for farming. Rural-rural migration accounts for a substantial part of the total migrant flows in Ghana (Ghana *Population and Housing Census,* 2002). One of the principal regions of rural out-migration from Northern Ghana to Southern Ghana is the Upper East Region (Zachariah and Condé, 1981; Ghana *Population and Housing Census,* 2002).

To appreciate better why rural migrants move in Ghana and their choice of destination, one needs to understand the relationship between population and land. Most rural farmers in Ghana rely on rainfed agriculture. Forestlands, semi-arid lands and other agricultural lands that provide food and other means of sustenance are found in the rural areas. Consequently, scarcity and depletion of these resources in the rural areas tend to induce out-migration. Standing (1985) once noted that migration is not a choice for poor people, but migration seems to be one of the viable options for survival. In particular, rural farm households with less land or fertile land per household member are likely to count on migration as the first best option in escaping rural poverty. People from Northern Ghana essentially migrate to the south to take advantage of the better agro-ecological resources which are suitable for agricultural production (Caldwell, 1963; Beals *et al.*, 1970).

One of the potential destinations of Upper East rural migrants on their way to the South to seek for better employment opportunities is the Brong Ahafo Region (Nabila, 1997; Ghana *Population and Housing Census,* 2002). An estimated 70 percent of the population in the Brong Ahafo Region is engaged in agriculture. Techiman and Nkoranza Districts alone have about 501 and 120 predominantly rural settlements respectively where the economically active population depend on agriculture for their livelihood (Ghana *Population and Housing Census,* 2002). Typical rural migrants from the Upper East Region lack the requisite of formal educational skills and qualifications necessary to compete for fewer non-agricultural wage-earning jobs in the Brong Ahafo Region. They undertake food and cash crop

production on lands which indigenous landowners periodically put to fallow (Benneh, 1987).

Land rental contracts are effective entry points for the landless to access land for farming. The temporary transfer of land through fixed or sharecropping tenancy is an institutional arrangement between rural migrants and landowners in the Brong Ahafo Region. Access to land allows landless farm households to employ their labour endowments profitably (Otsuka, *et al*., 1992). Other economic incentives, however, must exist before landowners would enter into rental contracts with migrant tenants or self-cultivate. For example, owners would rent-out plots to tenants if supervision and monitoring costs are low. Also those with limited labour for supervision on hired farm labour due to old age and absenteeism will find it more appropriate to rent-out land than to self-cultivate. Moreover, land owners with more access to working capital would rather self-cultivate than to rent-out land to tenants (Eswaran and Kotwal, 1985). Due to market failures, institutional gaps such as lack of credit and insurance, and liquidity constraints, not all landless farm households could access land. Apart from liquidity for purchasing labour and other variable farm inputs, in most cases, liquidity is needed for advance payment for fixed-rent plots. Those with liquidity problems have no option but to enter into sharecropping agreements with landowners.

Migrant farm households do not allocate their time endowments to on-farm work only. Indeed they simultaneously allocate part of their time endowments to off-farm work especially during slack seasons of agricultural production as hired labourers in other peoples' farm or engage in small-scale self-employment business activities as a means of generating the necessary income for the household. Wage labour and self-employment tend to be one of the income strategies employed by rural households who wish to access land for farming or vice versa (Sadoulet, *et al*., 2001) and for remittance to the home area. Earnings from off-farm employment may reduce liquidity constraints, assist farmers to increase the area under tenancy contracts and enhance the financing of farm input acquisition including the hiring of farm labour.

The use of agricultural technologies by rural migrants on plots rented on short-term basis has implications for the quality of the environment. Due to tenure insecurity on rented plots, there is little guarantee that migrants could keep rented land for use in future so the tendency is for farmers to use the land continuously. Although intense cultivation on the same plot of land without fallow could be a potential source of land degradation, migrant tenants may adopt sustainable land use practices as a means of maintaining the quality of rented plots. This then raises a number of research questions. What are the economic and environmental implications of the rural migration from the Upper East Region to the Brong Ahafo Region of Ghana? Specifically, how much land area is cultivated under fixed-rent and sharecropping contracts in Techiman and Nkoranza Districts and what are the effects of the determinants of these? How much do migrants earn from on-farm and off-farm work? What agricultural technology is employed by the migrant households in on-

farm income generation? What are the effects of the determinants of off-farm work participation? What are the determinants of migrant remittances to the home area? What short-term investments do migrants undertake in maintaining the fertility of rented plots? These are the issues which the present study addresses.

1.2. Objectives of the Study

The primary objective of this study is to analyse the economic and the environmental linkages of rural migration from the Upper East Region to the Brong Ahafo Region of Ghana.

The specific objectives are the following:

- To describe the rural migration from the Upper East Region to the Brong Ahafo.
- To analyse how Upper East migrant farm households in Brong Ahafo acquire land for farming.
- To determine how Upper East migrant farm households generate on-farm income including the use of agricultural technology in Brong Ahafo.
- To determine how Upper East migrant farm households generate off-farm income in Brong Ahafo.
- To quantify the effects of remittances to the migrant's home area in the Upper East.
- To analyse the implications of agricultural production of Upper East migrant farm households on the quality of the environment in Brong Ahafo.

1.3. Justification of the Study

This study partly builds on an earlier sponsored project by The Netherlands Organisation for Scientific Research (NWO) in which the impact of migration on the environmental conditions in the Upper East Region of Ghana was examined. One of the findings of the study is the large extent of rural-rural migration to the most resource-endowed regions in the forest zones of Southern Ghana. While migration by itself may have a positive effect on the region of origin (though empirical evidence is ambiguous), its effect on the region of destination should also be included to complete the environmental accounting. In assessing the impact in the region of destination, short-term effects must be distinguished from long-term effects. The former is initial felling of trees and more intensive land use, and application of techniques, particular to the migrant households. In the longer term, migrants could be expected to follow the examples set by the resident population of that region and adjust their techniques, probably plant new trees etc. This process of adjustment is not earlier assessed on its environmental implications. The study thus extends the debates on demographic changes, migration and its environmental implications.

One of the challenges facing rural landless migrants at their place of destination is land acquisition. Landless tenants may benefit economically from land tenancy arrangements as it allows them to generate income from rented land through food crop production. Literature on land tenancy arrangements has been extensive and dates back to Alfred Marshall (1920) who hypothesised the inefficiency theory of sharecropping contracts. Marshall was of the view that because the tenant receives only a fraction of his marginal product of labour in sharecropping, his work incentive or effort would be adequately rewarded if he signs a fixed-rent contract with the landowner. The works of Bardhan and Srinivasan (1971), Stiglitz (1974), Bell and Zusman (1976), Lucas (1979) and Shetty (1988) among others, have all advocated and alluded to the Marshallian thesis. Cheung (1968, 1969) and Newbery (1975) however proposed other competing models to the original sharecropping models. They contended that contract offered by the landlord will not stipulate the tenant's share of output but also labour input to be applied on the land. Eswaran and Kotwal (1985) investigated land tenancy contracts in which the share and fixed rent parameters were endogenously determined. An empirical survey by Otsuka and Hayami (1993) provided a modelling framework in which land, labour and owner-cultivation were considered together. Most of the literature mentioned above has concentrated on Southeast Asia, Central America and other parts of the world with little or no attention to Ghana (Mortimore, 1997; Amanor with Kude Diderutuah, 2001; Kasanga and Kotey, 2001).

The original study by Polly Hill in 1963 and Boadu's empirical study in 1992 focused only on tenancy contracts within the cocoa industry of some parts of Southern Ghana. The Besley (1995) study of how tree planting increases the possibility of land rights and the Otsuka, *et al.* (2003) analysis of the effects of land tenure on land use and management have contributed to the existing body of land tenancy literature on Ghana. They did not, however, test the hypotheses by estimating food crop production but rather concentrated on tree planting (cocoa) and fallow choice. The recent study by Amanor, *et al.* (2002) which paid attention to tenancy arrangements between settlers and indigenous owner-cultivators in food and cash crop production in the Brong Ahafo Region was merely descriptive as the effects of these tenure arrangements were not quantified. The current study brings into perspective, detailed analytical, theoretical and empirical insights on the amount of land cultivated under tenancy contracts by landless tenants in a framework in which land, labour and owner-cultivation are modelled together.

In the Brong Ahafo Region, migrant farm households could grow a variety of crops under forest and savannah conditions. Techiman in Brong Ahafo, for instance, serves as a feeder market which influences prices of food commodities in the local markets such as Bolgatanga in the Upper East (Abdulai 2000). To improve upon their relative income positions, the migrant farm households allocate their time endowments to both on-farm and off-farm work. Despite the multiple sources of income generation within farm households, the choice for on-farm or off-farm work depends on the returns from these activities. The migrant farmer must be financially

self-sustaining at the place of destination before he could maintain the family ties and bonds in the home area through remittances and regular visits. The ability to remit may depend on income generation from on-farm work and off-farm work. Moreover, the effects of the determinants of remittances from rural migrants from the Brong Ahafo Region to the Upper East Region are largely unknown.

Despite the absence of the rural migrant farm households from home, they are still part of the extended family. Some migrants entered into some informal agreements with relatives, wives, and children before permission was granted for them to leave. The Ghanaian family system recognises the bond of relationship between family members through mutual dependency, co-operation and support (Adeku, 1991). Traditionally it is morally binding for husbands to feed, clothe, shelter and provide for the support and comfort of their wives and children. The responsibility to the migrant husband then becomes imperative since he is the breadwinner of the family. Negligence or failure attracts the displeasure of both family and community. Migrant remittances could impact positively on the development and welfare of the nuclear and extended families in the rural areas if they were used in agricultural production and development of small businesses. The existing literature on remittances on Ghana has focused on urban-rural remittances or vice versa (Caldwell, 1969; Tutu, 1991) and on international remittances from Ghanaian migrants living outside the country (Zachariah and Nair, 1980; Ammassari and Black, 2001; Mazzucato, 2006). Despite the importance of remittances as a device for income redistribution within the rural household, less empirical evidence exists in Ghana on remittances from rural out-migrants to their rural areas of origin. The current study investigates this phenomenon and contributes to closing this gap knowledge.

Agricultural production and the quality of the environment have been a matter of great concern to policy makers in Ghana. The conversion of forestland to agriculture could lead to substantial economic benefit by providing sustenance to the rapidly growing population, but when farmers fail to adopt sustainable land use practices, the livelihoods of forest-dependent people may be undermined and forest-based foreign exchange revenue lost. Ghana's Environmental Action Plan confirms this point (EPA, 1994). Attempts have been made to explain the sustainable use of agricultural lands in Brong Ahafo from the ecological, historical and narrative points of view (Amanor, 1993; Leach and Fairhead, 2000; Leach and Mearns, 1996). Afikorah-Danquah (1997), for instance, provides descriptive analysis on forest management by farmers in the Wenchi District of Brong Ahafo. These studies, however, did not highlight how settler farmers in particular, manage the quality of rented land in the absence of clearly defined property rights. The current study uses farm household data to explore this possibility among Upper East migrant households in the Techiman and Nkoranza Districts of the Brong Ahafo Region. This study is therefore important.

Policies distilled from the study when implemented by the relevant local and governmental agencies could assist in the rural development of both the sending and

receiving areas in Ghana. For example, the results of the present study could enhance the design of a better institutional framework for land tenure arrangements, provision of farmer credit and inputs, and the promotion of rural micro-enterprises which could facilitate easy entry into both farm work and off-farm work and minimise negative effects of migrant agricultural activities on the quality of the environments.

1.4. Organisation of the Study

The current study is organised in nine chapters. The farm household survey is described in Chapter 2. The data were collected from two representative administrative districts with high percentage of Upper East farm households in the Brong Ahafo Region. Four villages each from each of the two representative districts were selected after which a simple random sampling of Upper East migrant farm households in the selected villages was undertaken. The questionnaire design and administration are briefly outlined.

Chapter 3 describes the study area. We make a distinction between the agro-ecology of the Upper East Region (the place of origin of the migrants) and the Brong Ahafo Region (the place of destination of the migrants). The climatic conditions, geology, soil, and vegetation are discussed. The agricultural activities in the two regions are described. The sequence of migration and the dynamics of the rural migration flow from the Upper East to the Brong Ahafo are explained. We analyze in this chapter, the population trends in Techiman and Nkoranza based on Ghanaian census data and the farm household data collected in the Brong Ahafo Region in the present study.

Chapter 4 explores how Upper East migrant farm households acquired land for farming in Brong Ahafo. The chapter is structured as follows. The rules and customs of land acquisition in the Brong Ahafo Region are discussed. The institutional land tenure arrangements between tenants and indigenous landowners are examined. An overview of the literature on the choice of tenancy contracts is given. We explain the renting-out and renting-in of land between tenants and owners. Input intensities and yields on rented and owner-cultivated plots are also explored. A theoretical model of land area cultivated under tenancy contracts is formulated, followed by an empirical investigation and simulations.

In Chapter 5, we investigate the on-farm income generation of the migrant farm households. The chapter is presented as follows. The household's crop choice and sale of farm produce are discussed. The marginal contributions of various crops to the household's income are assessed with economic returns of single crops and for some crop combinations. The labour inputs and the household's demand for hired farm labour are analyzed. Finally, the production technology of the farm households is investigated.

Chapter 6 shows that off-farm income generation is one of the economic opportunities opened to Upper East farm households in Brong Ahafo. We look into the nature of their off-farm employment activities and quantify the earnings from the employment activities. The determinants of off-farm work participation and wage offer functions for the households are explored. The choice between on-farm and off-farm work is explained. The labour supply response of the farm households is also investigated.

Chapter 7 considers the remittances from the destination households to the home area. A comprehensive review of the literature on the determinants of migrant remittances is given. We also examine the linkages of the migrant farm households to the home area with the farm household data. The volumes of remittance flow between the migrant's destination and origin are evaluated. The effects of the determinants of remittances from the destination to the home area are quantified.

The implications of migrant agricultural activities on the quality of the environment at the migrant's place of destination are evaluated in Chapter 8. This is achieved by looking into the sustainability of the fertility on migrant plots.

Chapter 9 presents the summary of findings and conclusion, makes some policy recommendations, and offers suggestions for future research.

Chapter 2

The Farm Household Survey

The farm household survey was conducted in the Brong Ahafo Region of Ghana between February and October 2003. Selection of districts, villages and farm households were undertaken during this period. The survey period covers the recruitment and training of enumerators, design of household questionnaires for the study, pre-testing of the questionnaires and the actual survey interview. The survey was carried out in three steps. Two administrative districts in the Brong Ahafo Region where Upper East migrants are located were first selected followed by a selection of villages from the two selected districts. Finally, a simple random sampling of Upper East migrant farm households from the selected villages was undertaken.

The procedure used in the selection of the districts, villages and the migrant farm households are described in detail in this chapter. The approach adopted in the design of the farm household questionnaire is also given.

2.1. Selection of Districts

The first task in the farm household survey was the selection of districts in the Brong Ahafo Region in which Upper East migrant farm households have settled. The Brong Ahafo Region has 13 administrative districts but not all these districts contain Upper East migrant farm households. To identify the districts with sizeable proportions of Upper East migrant farm households, Ghanaian census data were obtained from the Ghana Statistical Service. The population censuses in Ghana were conducted in 1960, 1970, 1984 and 2000. Data from the population census provide detailed statistics on population trends of various ethnic groups at the place of enumeration.

Predominantly, Wenchi, Techiman, Nkoranza and Kintampo are the administrative districts in the Brong Ahafo Region where food and cash crops are grown on a larger scale and where sizeable proportions of Upper East migrant farm households are located. Nkoranza and Techiman were selected as the study districts for the present survey. Although Kintampo has a larger proportion of Upper East migrant population than the corresponding proportion in Techiman (Table 2.1), Techiman was selected over Kintampo because of the economic importance of Techiman. The Techiman Township is a large market centre which links Northern Ghana to the South in terms of food and cash crop marketing. Techiman and Nkoranza attract a lot of rural migrants from the North because of their important geographical location in the transitional zone. The mixed agro-ecological belt of the transition zone provides a better comparative study of the environmental implications

of the farming practices of the rural migrants than areas exclusively located in a savanna or forest zone.

Table 2.1. Distribution of Resident Northerners in Brong Ahafo Region

	Migrants from Northern Ghana		
District	North (%)	Upper West (%)	Upper East (%)
Wenchi	2	92	6
Techiman	4	80	16
Nkoranza	15	58	27
Kintampo	10	70	21
Brong Ahafo	8	75	17

Source: Author's Compilation from Ghana *Population and Housing Census*, 2002, Ghana Statistical Service.

2.2. Selection of Villages

The next task involved locating villages in the study districts where Upper East migrant farm households have settled. To avoid biasing the selection procedure, villages with recent and old migrant farm households from the Upper East and indigenous villages where Upper East migrant farm households have settled were considered. This approach was preferred so that the implications of agricultural activities of recent and old migrants on the quality of the environment could be controlled. Since no sampling frame existed for the villages populated with Upper East migrant households in the selected districts, reconnaissance visits were made to Techiman and Nkoranza and all villages populated with Upper East migrant farm households were listed. Applying a simple random sampling procedure, eight villages, specifically, four from each district were chosen as the study locations.

Table 2.2 shows the selected villages in each district. In the Techiman District, Aworopata, Woraso, Twimea-Nkwanta and Nkwaeso were selected. Woraso and Aworopata are entirely migrant settlements with very little or no indigenous population but Twimea-Nkwanta and Nkwaeso are indigenous villages populated with Upper East migrant farm households. Twimea-Nkwanta for instance is gradually becoming one of the suburbs of Techiman town due to rapid urbanisation. Hence, most migrants in this village are predominantly part-time farmers who combine farming with other non-farm employment activities in Techiman. In the Nkoranza District, Ayerede, Donkro-Nkwanta, Damango and Dromankese were selected. These locations are old indigenous villages with sizeable proportions of Upper East migrant farm households. However, the proportions of Upper East migrant farm households in Ayerede, Donkro-Nkwanta and Damango were relatively small compared to other villages so these 3 villages were grouped together and renamed the Ayerede zone. Moreover, these villages were closely located and had similar agro-climatic

conditions. Grouping them together then minimised measurement errors, increased precision for a given sample, facilitated repeated visits in which supplementary questions had to be asked and reduced the cost of the survey.

Table 2.2. Distribution of Individuals Interviewed in Sampled Households

Districts	Villages	Migrants			Landowners		
		Male	Female	Total	Male	Female	Total
Techiman	Twimea-Nkwanta	37	30	67	9	1	10
	Nkwaeso	28	25	53	5	5	10
	Aworopata	19	15	34	6	4	10
	Woraso†	27	30	57	8	2	10
	Total	**111**	**100**	**211**	**28**	**12**	**40**
Nkoranza	Ayerede zone*	53	53	106	20		20
	Dromankese	20	12	32	15		15
	Total	**73**	**65**	**138**	**35**		**35**
	Overall Total	**184**	**165**	**349**	**63**	**12**	**75**

Note: * Ayerede zone comprises of Ayerede, Donkro-Nkwanta and Damango.
† Some household heads in Woraso had more than one wife.
Source: Author's compilation from NWO Survey (2003).

2.3. Selection of Migrant Farm Households

A simple random sampling was used in the selection of the migrant farm households in the study villages. Firstly, all the Upper East migrant farm households in each of the four villages in the selected districts were listed, a procedure which was necessary so that a random starting point for the households could be chosen (Deaton, 1997). After the enumeration, about 50 percent of the listed farm households were randomly selected. To capture the contributions of female migrants to the overall household's income from on-farm and off-farm income generating activities, migrant wives of the same farm households were also interviewed. The same sampling procedure was applied to owner-cultivated households as well. The unit of analysis is the household. Hence male household heads interviewed which constitute the actual sample used in the analysis of the survey data was 184 for migrant households and 75 for indigenous owner-cultivated households.

Some difficulties were encountered in the data collection. Migrant household heads with low educational background had some difficulty in providing information on questions concerning previous activities. Farm households in which enumeration errors were encountered were rejected. In the Nkoranza District, some nearby villages of Dromankese which had a sizeable proportion of Upper East migrant farm households such as Junction and Dromankuma could not be covered in the survey due to difficulties in reaching these remote villages and the fact that the farm

households in these villages were scattered. Hence, more farm households were sampled in Ayerede, Damango and Donkro-Nkwanta.

2.4. The Questionnaire Administered

To generate the necessary data for the study, household-level questionnaires were designed for migrant and indigenous owner-cultivated households. To capture the livelihood strategies of the migrant farm households, focus group discussions and informal interviews were held at Dromankese in the Nkoranza District and Aworopata, Woraso and Twimea-Nkwanta in the Techiman District (Annex 2.1). In Dromankese, about 34 participants comprising 28 males and 6 females participated in the group discussions. About 28 males and 5 females also participated in the focus group discussions held at Aworopata whilst in Twimea-Nkwanta, 37 farmers comprising 29 males and 8 females participated in the group discussions. Another focus group discussion was held at Dromankese in the Nkoranza District for only migrant women (Annex 2.2). About 33 women participated in this discussion. The responses from the focus group discussions and informal interviews (Annex 2.3) provided a background on specific questions to include in the questionnaires so that the study's objectives of assessing how the migrants had settled, how they accessed land for farming, off-farm income generating activities and remittances, and the implications of their agricultural activities on the quality of the environment could be achieved.

In the questionnaire for migrant farm households, male heads were asked about their personal history and in-migration, the household's composition, plot-level characteristics, present and future use of plots, household income and assets, risks in agricultural activities, non-farm business activities, household expenditures and remittances. Questions asked on present use of plots included the crops grown, land preparation, input use, labour use on plots (hired and family), yields, income from crop output, and land improvement methods adopted on rented plots (see Appendix 1 for the migrant household questionnaire). With the exception of the history of in-migration and remittances, landowners were asked similar questions (Appendix 2 provides the household questionnaire for the landowners).

Before the actual survey, drafts of the questionnaires were pre-tested twice in each selected village and necessary changes effected after feedback from the enumerators. Extension officers from the District Office of the Ministry of Food and Agriculture (MOFA) at Techiman and Nkoranza and professional teachers familiar with census enumeration were employed as enumerators to administer the questionnaires. The selected enumerators were trained and equipped with the necessary communication and quantitative skills to ensure proper data collection. The enumerators were closely monitored and supervised so that proper and required information were solicited during the data collection period.

Technical assistance on the farm household survey, and other qualitative information needed to complement the quantitative survey data were sought from the District Directorate of Ministry of Food and Agriculture (MOFA), District Assemblies and Forestry Departments in Techiman and Nkoranza. Some environmental NGOs with previous collaboration with settler farmers in Techiman and Nkoranza such as the Adventist Relief Agency (ADRA) and TechnoServe (TNS) were consulted.

The Chapter which follows describes the study area. The population trends and migration dynamics in the study area are also analysed with Ghanaian Census data and the present study's farm household data.

Annex 2.1. General Focus Group Discussions

Variable	Dromankese (Nkoranza)	Aworopata (Techiman)	Twimea-Nkwanta (Techiman)
Attendance	28 males, 6 females	28 males, 5 females	29 males, 8 females
Ethnic group	Frafra, Gurunshi, Builsa	Kusasi, Frafra, Kasena -Nakani, Builsa	Busanga, Kusasi, Gurunshi
Origin in Upper East	Bolgatanga, Navrongo, Sandema	Bawku ,Bolgatanga Navrongo, Sandema.	Bawku, Bawku & Navrongo, Navrongo
Year of Arrival	1978	1991 1992 1995 1983	1991
Reason for Migrating	Soil degradation, population growth and pressure on land, lack of education	Lack of rainfall, delay in rains, pressure on land, land degradation, lack of soil fertility, financial difficulties, lack of good infrastructure facilities.	Improve upon their lives, seek good land for farming, no food to eat, poor land, poor yields, fertile land at home very expensive
If Migrant Reached Some Level of Under-standing with Origin Family	Yes	Yes	Yes
Land Tenure	Sharecropping: 'Abusa' Leased-land ¢60,000 for yam. ¢30,000 – ¢40,000 per acre for inherited land.	Sharecropping: 'Abusa' for maize, 'Abunu' for cocoyam & cassava.	Sharecropping: 'Abusa' Leased-out land: ¢300,000 –¢400,000 per acre for 3 years. ¢1,500.000 per acre for only 2 years for forestland.
Labour	Hired, family & own labour.	Hired labour : 22%, Exchange Labour (*Nnoboa*) : 78%	Hired, family & own labour.

Annex 2.2. General Focus Group Discussions (**Continuation**)

Distance of Plots from Home	Short distance: 6.4 km. Long distance: 12.9 km. Car, none; Bicycle, 25% Walk, 75%	Short distance: 6.4- 9.7 km. Long distance: 14.4-16.1km. Car, none; Bicycle, 33% Walk, 67%	Short distance: 6.4 km. Long distance: 11.3-16.1 km. Car, 67%; Bicycle, none; Walk, 33%
Crops grown	Yam, maize, groundnut Vegetables such as tomato, pepper and garden eggs.	Maize, millet, sorghum, cassava, tomato, pepper & garden eggs.	Yam, cassava, maize, beans groundnut and onions.
Fallow Period	3 years cultivation 7 years fallow period	3 years cultivation Sharecrop, 2-4 years	3 years for sharecropping. 2-3 years leased land.
Tree Planting	Cashew & Teak	Cashew. Migrant looses ownership when trees mature.	Cashew & Teak
Livestock	Sheep, goats and pigs	Sheep, goats & fowls	Sheep, goats & cattle
Non-farm Employ-ment Activities	Charcoal burning, Cooked food, processing of 'gari' (fried grated cassava)	Cooked food: 'banku', 'kenkey' and porridge all prepared from fermented milled maize, rice, 'koose' & brewing of 'pito' (sorghum beer).	Retailers in sawn wood (at the timber market in Techiman town), groundnut millet, handicraft (weaving of traditional Muslim hats), cobblers and bicycle repairers.
Remittances	About 80%, 2 bags of maize. 20%, a bag of maize. Some send yams and/or cash.	46%, 2 bags of maize. 27%, 1 bag of maize. 27%, no remittance	39%, 2 bags of maize. 31%, 1 bag of maize. 16%, 4 'olonka' of maize. Occasional cash remittance.

Annex 2.3. Women Focus Group Discussion

Purpose	To capture gender aspects of migrant activities
Venue	Dromankese.
Day	Market day (Thursday)
Attendance	33 migrant women comprising of 22 Frafra, 2 Gurunshi, and 6 Kasena Nankani. No Kusasi or Busanga migrant present. 3 of them were of Brong and Frafra origin.
Education	5 primary, 1 secondary and 27 had no formal education.
In-migration	15 came with their husbands, 15 came on their own and 3 were born at Dromankese to Brong mothers. Only two of them were household heads. The rest indicated they were living with their husbands.
Land Tenure	63 percent farm jointly with husbands and 47 percent of them had additional plots on their own. Among those with additional plots, 48 percent had their plots through their husbands, 38 percent acquired them on their own and 19 percent had theirs through paternal inheritance. None of them was a sharecropper.
Crop Cultivation	About 71 percent took active part in land preparation such as weeding when household is short of cash. The rest could afford hired labour for land preparation. Apart from the traditional crops such as maize, yam and beans cultivated by migrants from Upper East, they also cultivate crops like fibre, green leaves ('yoyo') and vegetables like okro and pepper.
Land Sustainability	Very few plant trees. Fertility on plots is restored through bush fallowing normally undertaken by indigenous landowners and through shifting cultivation. Fallow periods are between 3 to 4 years. Only one of them applied fertiliser on plots, others improve yield by constructing ridges and mounds.
Off-farm Work	70 percent had husbands working only on-farm. 30 percent had husbands in some form of off-farm activities. Off-farm employments include petty trading, selling of cooked food, charcoal burning, 'gari' processing and seamstress. Off-farm income supplements household income, assists in expansion of family farm and remittances.
Remittances	Migrant women remit during periods when households in Upper East Region face acute food shortages due to poor yields. 81 percent remit cash, 19 percent remit food such as maize and yam. High transportation costs make remittance of food difficult. Cash transfers assist in the purchase of food for family upkeep and for payment of children's school fees. Investment of cash remittances in farm sustainability is secondary to most origin households.

Annex 2.4. Summary of Group Discussions

- Upper East migrants in Brong Ahafo migrated to escape population pressure on land and poor quality farmlands at home.
- Lack of requisite formal education compels them to enter into agriculture when they settle in Brong Ahafo.
- Sharecropping and fixed-rent contracts are the main tenurial arrangements through which migrant farm households access land for farming.
- Most male migrant household heads have joint plot with their wives and children. Very few migrant wives had separate plots.
- The traditional land tenure institution in the Brong Ahafo Region restricts migrants to plant economic trees on rented plots. These lead to continuous cropping and short fallow periods.
- Livestock are kept in almost all the households to serve as a means of financing farming activities.
- More migrant wives are involved in off-farm business activities than their male counterparts. Income generated from off-farm work contributes significantly to the overall household income and forms a bulk of cash remittances to the home area.
- Cash and in kind remittances are regular features of most migrant households. Food such as maize and yam are sent annually to relatives in the Upper East Region while they also receive food from relatives in the Upper East Region.
- Frafra migrants in Dromankese and Kusasi migrants in Aworopata with the intention to return permanently to the Upper East Region have housing investments in their home area but those with no intention to return permanently such as the Busanga migrants at Twimea-Nkwanta have housing investments in the Brong Ahafo Region.
- Short-term benefits of the rural migration to the migrants are income from on-farm and off-farm work.
- Migrants undertake short term land improvement methods on rented land.

Chapter 3

The Study Area

This Chapter describes the study area. It compares the agro-ecology of the Upper East Region (specifically, the place of origin of the migrants) and the Brong Ahafo Region (specifically, the place of destination of the migrants). These include descriptions of the climatic conditions, geology, soil and vegetation. The agricultural activities of farmers in the two regions are discussed. The migration dynamics from Upper East to Brong Ahafo is explained. A description of the population trends in Techiman and Nkoranza is given, followed by a description of the rural out-migration from the Upper East to Brong Ahafo.

3.1. Location of the Area

The size of the Brong Ahafo Region is about 39,557 square km. The region lies within longitude 0^{o} 15´ East and 3^{o} West and latitude 8^{o} 45´ and 7^{o} 3´ North. It is bounded by the Northern Region to the North, Ashanti and the Western Region to the South, the Volta Region to the East, Eastern Region to the Southeast and Côte d'Ivoire to the West. The Techiman and Nkoranza Districts form part of the 13 administrative districts in the region. The Techiman District is located within longitudes 1^{o} 49´ West and 2^{o} 30´ West and latitudes 8^{o} 00´ and 7^{o} 35´ North. The Nkoranza District is bounded by longitude 1^{o} 10´ West and 1^{o} 55´ West, and latitudes 7^{o} 20´ and 7^{o} 55´ North. In terms of physical boundaries, Techiman lies to the West, Kintampo to the North, Atebubu to the East and the Ejura/Sekyeredumase District in the Ashanti Region to the South of the Nkoranza District. The Techiman District comprises 501 settlements and covers an area of about 667 square km. The Nkoranza District covers a total area of 2,300 square km and comprises 136 settlements of which 120 are predominantly rural.

The size of the Upper East Region on the other hand is about 8,840 square km. It is located between longitudes 0^{o} and 1^{o} 30´ West and latitudes 10^{o} 30´ and 11^{o} North. The region shares the boundary with Burkina Faso to the North and the Gambaga Scarp, the White Volta and its tributary Kulpawn River form the southern boundary. The region is bounded to the south by the Northern Region. The Upper West Region lies to the West. The Sisilli River forms the boundary between it and Togo to the East. Whilst the Brong Ahafo Region is located within the transition zone in the middle parts of Ghana, the Upper East Region is located on the eastern part of Northern Ghana. The size of Brong Ahafo is larger than that of Upper East by a ratio of 5:1. Both regions are predominantly rural.

3.2. Climate

The Brong Ahafo Region on the whole has an average temperature regime of about 23°C (75°F) and a bimodal annual rainfall pattern. The Techiman and Nkoranza Districts have tropical savanna and wet semi-equatorial climates. The average monthly temperature of Techiman is around 30°C (80°F). The warmest period occurs between March and April and the lowest of about 26°C (79°F) occurs in August. Nkoranza has an average annual temperature of about 26°C. The long rainy season in Techiman and Nkoranza begins in March and ends in July and the short rainy season lasts from September to November. Techiman has a characteristic high rainfall of over 1650 mm towards the Southwest and declines to about 1250 mm around the Northwest in the Guinea savanna zone. Nkoranza has a mean annual rainfall level ranging between 800-1200 mm. In August, the district experiences a short dry season, but from December to March, Nkoranza experiences a long dry season. The relative humidities are highest around 75-80 percent during the rainy season and the lowest around 70-72 percent during the rest of the year.

The climate in the Upper East Region is characterised by wet and dry seasons due to the influence of the harmattan air mass and monsoon air mass. During the harmattan, the air is warm, dry and dusty but the monsoon air is warm, humid and wet. The mean monthly rainfall in the Upper East increases gradually from March until a maximum is reached in August with a gradual reduction in September and a sharp reduction in October. The average annual rainfall for the Upper East Region is considerably lowered by the high run-off during the rainy season and by high evapo-transpiration during the harmattan weather. According to Adu (1969), the prolonged dry season coupled with high incidence of grass cover burning expose the topsoil to erosion during torrential rainfall in the region.

Unlike the Brong Ahafo Region, which has a bimodal rainfall pattern annually, the Upper East Region has unimodal rainfall, which is characterised by erratic and torrential rainfall distribution every year. The Upper East Region in general is warm, dry and dusty but Brong Ahafo has humid characteristics in most parts of the region.

3.3. Geology

The land in the Techiman District is underlain by voltain and belt granite rock formations. The voltain formations are found around Nsuta, Agosa and Mangoase in the Southwest of the district. They cover about 90 percent of the total land area and are very rich in sandstones, shales, mudstones and limestone. Around Nsuta, Offuman, Agosa, New Techiman, Tanoso and Bamire, one can also find clay deposits. The soils in Nkoranza District are largely developed over voltain sandstones. The formation and characteristics of soils in the Upper East are influenced by the alternation of wet and dry climatic conditions (UNDP/FAO, 1967). The alternation accelerates chemical decomposition and deep weathering of rocks.

Gambaga Scarp, which is a steep escarpment, forms an important boundary between the Upper East Region and the Northern Region.

3.4. Soils

Three main soil groups can be distinguished in the Brong Ahafo Region. These are the Forest Ochrosols, covering the Southwest, the Savannah Ochrosols, stretching from the West and gradually narrowing towards the East as a wide belt of Ground Water Laterites and Laterite Ochrosols integration. The soil associations in Techiman and Nkoranza are the Damango-Murugu-Tanoso Association; the Bediesi-Bejua Association; and the Kumasi-Offin Association. The Damango series formed under savanna vegetation are favourable for cultivation of crops like yam, cassava, maize, tobacco, vegetables, legumes, and cotton. Similar to the Damango series, the Murugu is found in the transition zone and are suitable for maize, cassava, cotton and tobacco cultivation. The Tanoso series are deep, poorly drained and subjected to seasonal water logging. The Bediesi-Bejua Associations are developed from voltain sandstone under forest vegetation and are suitable for crops like cocoa, coffee, oil palm, and plantain. They are found in the Asubima Forest Reserve. The Kumasi-Offin Association supports the growth of both arable and tree crop cultivation.

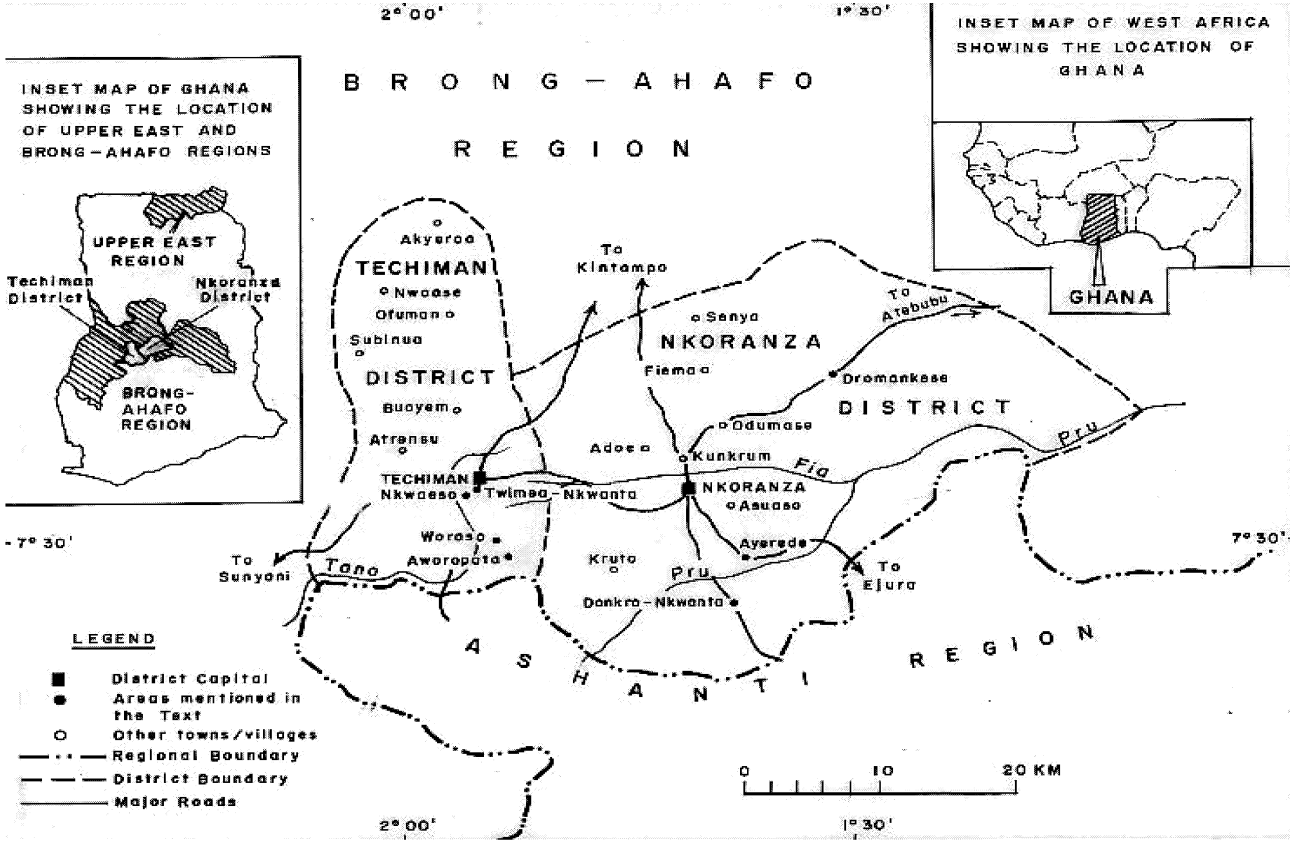
The soils in the Upper East Region have characteristics common to those in the interior savannah zone of Ghana (Adu, 1969). Compared to soils in the forest zones, the soils in the region have a lower phosphorus and nitrogen status. The productivities of the soils are lower than most forest soils because of the unfavourable moisture regime and unreliable rainfall in the region. The high temperature regime, rapid soil decomposition rates and annual burning of vegetative cover in the region, result in soils with usually low organic matter content.

The soils in the Upper East Region are broadly classified into 21 associations. Those in Techiman and Nkoranza are of 3 main associations. Each soil association in the Upper East Region consists of a group of soils with some characteristic profile such as topographical sequence and variation in soil characteristics within short distances. The valley soils are of the alluvial type formed under hydromorphical conditions but the upland soils formed from decomposition of parent material are of the hydromorphic intergrades accumulated by erosion from the upper slopes (UNDP/FAO, 1967).

3.5. Vegetation

The Brong Ahafo Region has two main vegetation types. These are the moist-semi-deciduous forest, which stretches from the South to the Southeastern parts and the guinea savannah woodland, located in the Northeastern part of the region.

Figure 3.1. Map Showing Techiman and Nkoranza Districts in Brong Ahafo Region



Source: Survey Department of Ghana – Accra

In addition to these, Techiman and Nkoranza are located within the fringes of the transition belt. In Techiman, the semi-deciduous zone is found in the South, the guinea savannah woodland in the Northwest and the transition zone, which comprises both forest and savannah vegetation, extends from the Southeast to the North. The semi-deciduous forest is relatively denser and characteristic of trees such as odum, wawa, teak, sapele and other indigenous trees. The Asubima Forest Reserve located in the Southwest around Nsuta, Bianhyewo, Kuntunso and Tanoso covers about 32.5 square km and represents about 5 percent of the total land area of the Techiman District. Notably, tree species like teak, odum, wawa and other indigenous trees are found in the reserve. Economic trees grown in the guinea-savanna woodland are cashew and mango. The eastern part of the Nkoranza District is largely characterised by savanna woodland, and fewer areas of savanna regrowth, made up of shrubs and grasses with few original tree species, especially silk cotton trees. Table 3.1 summarises the ecological zones of Brong Ahafo and the Upper East.

Table 3.1 Summary of Basic Ecological Features of the Study Area

Features	Upper East Region (migrant origin)	Brong Ahafo Region (migrant destination)
Rainfall (mm)	Max 1030 ; Min 740 Unimodal	Max 1650; Min 800 Bimodal
Major Rivers	Black Volta, White Volta, Sissili.	Tano, Subin and Kari.
Topography	Generally undulating, ranging from 150-300m	Highland points range from 305-597m and Lowland points range from 153-305m. Voltain and the belt granite rock formations, voltain sandstone.
Soil Types	Sandy loam, gravel.	Forest Ochrosols, the Savannah Ochrosols, Ground Water Laterites and Laterite Ochrosols integration.
Vegetation	Guinea Sudan Savanna	Semi-deciduous Forest and Guinea-Savanna Woodland.

Sources: Department of Agricultural Extension Services (1990), Benneh and Dickson (1988), MTDP-TDA (2002-2004) and MTDP- NDA (1996-2002).

The two main vegetation types in the Upper East Region are the closed forest and the savannah ecosystem. The closed forest zone has tall trees and occupies the Southwest while the savannah covers largely the northern two-thirds of the region.

The interior savannah consists of the Guinea and Sudan savannah. The Guinea savannah is the largest single vegetation occupying an area of about 12.9 million hectares in the central and northern parts of the country. The Sudan savannah covers an area of about 0.72 million hectares at the extreme Northeastern tip of Ghana around Bawku in the Upper East Region.

The Brong Ahafo Region and the Upper East Region have two main vegetation types each. The Brong Ahafo Region is characterised by the moist semi-deciduous forests and the guinea savannah woodland vegetation. The two main vegetation types in the Upper East Region are the closed forest and the savannah ecosystem.

3.6. Agricultural Activities

The Brong Ahafo Region is one of the food baskets in Ghana. On average, the region contributes about 30 percent of the nation's food requirements. The annual bimodal rainfall supports two cropping seasons. An estimated 70 percent of the population is engaged in agriculture. The creation of favourable environment for commercialisation of agriculture and an improved road network encourages migration into the transition zone of the Brong Ahafo Region. The main food crops cultivated are maize, yam, cassava and plantain. Cassava and maize are grown all over the Brong Ahafo Region. Rice, groundnuts, cowpea and cocoyam are also cultivated in Techiman and Nkoranza. The Brong Ahafo Region is the largest producer of maize (MTDP-TDA, 2002-2004). Cultivation of maize is undertaken mostly in Nkoranza, Techiman, Kintampo, and Atebubu. Large quantities of tomatoes are grown in Techiman, Nkoranza, and Wenchi. Tree crops like oil palm, cashew, cocoa, and coffee are cultivated on a large scale. Most cashew products in Ghana are produced in the Brong Ahafo Region. The Government of Ghana with support of the World Bank and the African Development Bank has also established teak plantation projects in the Brong Ahafo Region (Amanor *et al*., 2002). Cashew plantations are found in Techiman, Jaman, Wenchi, Atebubu, Kintampo, and Asunafo Districts. The Brong Ahafo Region is the third largest producer of cocoa after the Western Region and the Ashanti Region in Ghana.

Goats, cattle and poultry constitute the main livestock products of the region. The Structural Adjustment Programme (SAP) in the 1990s removed subsidies on inputs such as fertiliser, weedicides, and pesticides. To expose farmers to scientific methods of farming to boost food production, supported by some donor agencies, non-governmental organisations (NGOs) the Ministry of Food and Agriculture (MOFA) has undertaken a number of viable interventions in the region. The Integrated Pest Management (IPM) is practised with the assistance of MOFA. The District Agricultural Development Unit (DADU) in collaboration with the Ecumenical Association for Sustainable Agriculture and Rural Development (ECASARD) is promoting organic farming in Techiman. Agricultural Extension Officers carry out

demonstrations on latest technologies to farmers in a District Medium-Term Agricultural Development Programme. To reduce the demand for labour, the DADU, with support from Technoserve (TNS), the Crop Research Institute (CRI) and the German Technical Cooperation Agency (GTZ) has introduced the zero tillage mucuna system since 2000. In all 13 districts of the Brong Ahafo Region, the Ghana Government Roots and Tubers Improvement Programme (PRTIP) have been implemented.

Only one cropping season exists in the Upper East Region because of the unimodal rainfall pattern. Agriculture in the Upper East Region is mostly mixed farming. Food crops are also planted on compound farms, intermediate and bush farms in order to spread risks (Vergroesen and Zabel, 1978). In the compound farms annual staples and vegetables are fertilised with compost from household refuse and dung from kraals (Wills, 1962). Millet and sorghum are intercropped on compound farms. Groundnuts and bambara beans are cultivated on intermediate farms and commercials crops like rice, tobacco and cotton are grown on bush farms. Late millet, sorghum and maize are also cultivated on bush farms (Runge-Metzger, 1993). The bush fallow system which was originally used in agricultural expansion is being replaced by large, continuous cultivation due to increasingly deterioration of soils that also have little woody vegetation (Agyepong *et al.*, 1999).

Major food crops grown in the Bawku-Garu area of the Upper East Region are rice, maize and soybeans. In the last ten years, cotton has become one of the major cash crops grown in the region (Mensah-Bonsu, 2003). Grain yields are high in the Bawku East and Bolgatanga Districts (Dietz and Millar, 1999). The variations in yields of maize, sorghum, millet and groundnut in the Bawku East District are high whereas irrigated rice farming is less risky (PPMED, 1999-2001). Cattle, goats and sheep are some of the livestock kept in the Upper East Region. The number of cattle one possesses is an indication of the person's wealth in most northern communities of Ghana (Benneh and Dickson, 1988).

3.7. Migration Dynamics from Upper East Region to Brong Ahafo Region of Ghana

The level of out-migration from the Upper East Region to the Brong Ahafo Region is quite high (Nabila, 1997). High population densities in the Upper East Region have been cited as one of the factors contributing to this phenomenon. Compared with the rest of the regions in Ghana, the Upper East Region alone recorded one of the highest population densities from 1960 to 1984. By the end of the year 2000, it has risen to 104.1 persons per square kilometre as indicated in Table 3.2. Of the six districts in the Upper East Region, Builsa, Bongo-Nabdam and the Bawku West Districts recorded very high densities over 120 persons per square kilometre between 1960 and 1984 on a total land area of less than 600 square kilometres (Nabila, ibid.).

Benneh and Dickson (1988) have pointed out that it was the pressure on land around Bongo and Nangodi which led to the establishment of the Kparigu Resettlement Scheme in the 1940s and later the Damongo Resettlement Scheme in the 1950s. The roles of Bolgatanga and Bawku as regional and district capitals respectively may have added to the phenomenal increase in population of the two districts. Kasanga (1999) also finds that the Bawku East, Bolgatanga and Kasena Nakani Districts of the Upper East Region with population densities between 87 and 200 persons per square kilometre against the national average of 52 persons per square kilometre, currently face land shortages and environmental stress. Nabila (1997) further highlighted the extent of depopulation in households and locations in the Upper East by attributing it to population pressure on the environment, lack of good quality land for farming, poor infrastructural facilities and the non-existence of rural non-farm opportunities to absorb the excess agricultural labour.

Table 3.2. Population Distribution in the Study Area

Variable	Techiman	Nkoranza	Brong Ahafo	Upper East	Ghana
Area (km^2)	667	2,300	39,551	8,842	238,533
Population					
1960	34,642	38,591	587,920	468,638	6,728,815
1970	53,127	41,184	766,509	542,858	8,559,313
1984	90,181	93,791	1,206,608	772,744	12,296,081
2000	177,324	128,000	1,815,408	920,089	18,912,079
Population density (/km^2)					
1960	51.9	16.8	14.9	53.0	28.2
1970	79.7	17.9	19.4	61.4	35.9
1984	135.2	40.8	30.5	87.4	51.6
2000	265.9	55.7	45.9	104.1	79.3

Source: Author's Compilation from Ghana *Population and Housing Census,* 1960, 1970, 1984 and 2002, Ghana Statistical Service.

In almost all the districts in the Upper East Region a large proportion of the rural population depends entirely on agriculture for their living. According to Nabila (1997) and also noted earlier by Hunter (1967), the carrying capacity of land in the Upper East Region has far been exceeded because of continuous increase in agricultural population with no corresponding increase in available farmland. The vegetation in the Upper East Region has also changed due to long settlement, over population, and annual periodic fires. Adu (1969) has observed that by the 1960s, many areas within the region had changed to consist of degraded and fire resistant tree-savannah. Over 90 percent of the respondents in a socio-economic survey in the Upper East Region indicated that the vegetation was becoming poorer and attribute this development to farming activities, rampant burning of the bush, procurement of

firewood and overgrazing (Environmental Protection Council & Department of Geography and Resource Development, 1992).

Table 3.3. Minimum Wages in Terms of Kilograms of Maize that could be Purchased with a Day's Wages

Year	Seasonality	Bolgatanga	Techiman	Accra
1975	June	7.77	-	-
	December	6.77	-	-
1980	June	0.69	0.71	0.75
	December	2.50	-	0.87
1981	June	1.32	2.00	1.22
	December	1.92	2.40	1.60
1982	June	1.16	1.71	1.10
	December	1.99	1.50	-
1983	June	0.33	0.58	0.51
	December	0.82	0.98	-
1984	June	1.06	1.08	0.98
	December	2.15	5.09	2.90
1985	June	2.99	3.94	3.12
	December	3.84	3.85	2.67
1986	June	2.62	2.12	1.71
	December	3.54	2.81	2.17
1987	June	1.65	1.37	1.03
	December	1.53	1.73	1.37
1988	June	1.25	1.31	1.05
	December	2.08	2.71	1.90
1989	June	3.09	4.55	2.47
	December	3.32	4.02	2.91
1990	May	3.45	2.57	1.83

Note: The June and December prices are reported for four markets, although the major source of variation is over time and not regions. The minimum wage was revised in eight of the ten years covered.

Sources: Maize Prices from Ministry of Food and Agriculture, Ghana. Minimum Wages from Alderman (1991).

The Upper East Region and some eastern parts of the Northern Region seem to be affected by desertification (EPA, 1994). In the past, farmers in the Upper East used to allow the land to regain its natural fertility through shifting cultivation and land rotation but these land sustainability practices have reduced due to increases in population and demand for land by the non-agricultural sector (GGADP, 1983; Lynn, 1937). The limited land resources compels subsistence farmers to crop continuously on fragmented compound farms with dispersed settlement patterns whose fertility now depends on increased use of fertilisers and manures (GGADP, 1983). Hence as posited by Nabila (1997), the increasing population has exhausted the carrying

capacity of the land and invariably created serious environmental problems in the Upper East resulting in out-migration from the region.

Most rural farmers in Ghana practice rain-fed agriculture. The northern parts of Ghana have a unimodal rainfall season while the southern parts have bimodal rainfall annually. This skewed seasonal disparity in climatic conditions in favour of the South is a principal economic drive between the North and the South. The regional variation in seasonality of agricultural production is a factor which contributes to the rural migration flow from the Upper East to the Brong Ahafo. Seasonal migration in this sense is a circular migration (Prothero and Chapman, 1985; Twumasi-Ankrah, 1995). A study by Alderman (1991) shows that the seasonality in prices of maize is an economic advantage of Techiman (in the Brong Ahafo Region) over Bolgatanga (in the Upper East Region) of Ghana. Table 3.3 for instance indicates the ratio of minimum wage to the price of maize. Note that in terms of maize the real minimum wage fell sharply during the 1983 draught. Given that a kilogram of maize provides roughly 1.5 times the energy requirements of an adult, Alderman (1996) report that the wage rate was insufficient for an individual to adequately support dependents better in Bolgatanga than in Techiman in many years of the decade.

Using data from May 1980 to October 1997, the speed and magnitude of maize price transmission between Techiman and other principal markets such as Accra and Bolgatanga in Ghana has been analysed by Abdulai (2000). In line with Alderman (1993) and Badiane and Shively (1998), Abdulai reports that Techiman serves as the central market, with Accra and Bolgatanga serving as local markets. The wholesale market price in the Techiman market therefore appears to influence food prices in Accra and Bolgatanga, a reason attributed to Techiman's role as a feeder market from the maize-producing areas in Brong-Ahafo to Accra and Bolgatanga. For example, the study found out that the Techiman and Accra markets are linked by a constant absolute margin of 0.43 Cedis/kg, while the Techiman and Bolgatanga markets are linked by a constant absolute margin of 0.59 Cedis/kg. Abdulai (ibid) then concluded that Techiman is a dominant market and leader in price formation, to which price movements in local markets adjust in the long-run.

3.8. Population Trends in Techiman and Nkoranza Districts

The population of the Brong Ahafo Region stood at 1,815,408 during the 2000 Population and Housing Census in Ghana, of which approximately 60 percent live in the rural areas. The region has an average population growth rate of 3.1 percent. A DFID natural resource study in Brong Ahafo Region by Amanor *et al.* (2002) indicates that, from the 1920s, there has been a large influx of migrants from the Upper West and Upper East Regions, originally to the cocoa growing districts in Brong Ahafo but from the 1960s, the in-migration has been re-directed towards the northern transition zone purposely for food production. The Techiman District has seen a remarkable rise in population since 1960. Its population stood at 34,642 and

53,127 respectively in 1960 and 1970 but by 1984 it has risen to 90,181 with an intercensal growth rate of 2.7 percent.

By the year 2000, the population of Techiman District had reached 177,324 and by 2002 184,324. The high population growth rate in the Techiman District is partly attributed to the high in-migration rate of settler farmers from the North due to the available fertile lands in the district. As shown in Table 3.4, agriculture employed about 76.8 percent of the population in 1984. A socio-economic survey conducted in 1996 and 2002 indicated agriculture as a dominant economic activity employing as much as 62.8 percent and 69.5 percent respectively of the labour force in the district.

Table 3.4. Occupational and Labour Distribution in Techiman District

Year	Agriculture (%)	Commerce (%)	Service (%)	Industry (%)
1984	76.8	12.1	6.1	2.0
1996	62.8	6.1	13.5	4.6
2002	69.5	12.1	15.1	3.3

Source: Ghana *Population and Housing Census*, 1984, Ghana Statistical Service; DOP-UST Field Survey, February 1996/DPCU Field Survey 2002.

Moreover, about 48 percent of the labour force in 1996 are immigrants. Their presence made labour cheap and boosted economic activity in the region (MTDP-TDA 2002-2004). Techiman town, which is the district capital of the Techiman District, attracts a sizeable number of traders into the district because of the food market in Techiman. Techiman market is the largest food market in Ghana and an important commercial centre in West Africa. It attracts traders not only from within Ghana but from other neighbouring countries like Mali, Niger, Nigeria, Burkina Faso, Togo and Côte d'Ivoire. Within the country, traders in foodstuffs and other agricultural goods in particular, travel as far as the North, South and Western parts of Ghana to Techiman market weekly to transact business from Wednesdays to Fridays.

Both the Nkoranza District and the Brong Ahafo Region have relatively low population densities as compared to the national figures. These relatively low population densities, favourable rainfall patterns and good quality land pull rural migrant farmers from the northern parts of the country. In the North, high population densities, precarious weather conditions, prolonged dry seasons and poor quality soils compel farmers to out-migrate (MTDP-NDA, 1996-2002; Mensah-Bonsu, 2003). The Nkoranza District has also experienced a significant growth in its population from 38,591 in 1960 to an estimated figure of 93,791 in 1984. Table 3.5 depicts Nkoranza as a predominately rural area. Over 80 percent and 70 percent of the population were economically active in agriculture in 1970 and 2000, respectively. In 1984, only the Nkoranza Township could be considered as urban among all the 156 settlements in the district. By definition, an urban area is a location with a population of 5000 or more. In 1960, 16 percent of the population lived in urban towns. This increased to 17

percent in 1970 and 31 percent in 2000 but due to the occupational distribution in the district, the urban rate seems to be far lower than the national rate.

Table 3.5. Population Distribution in Nkoranza District

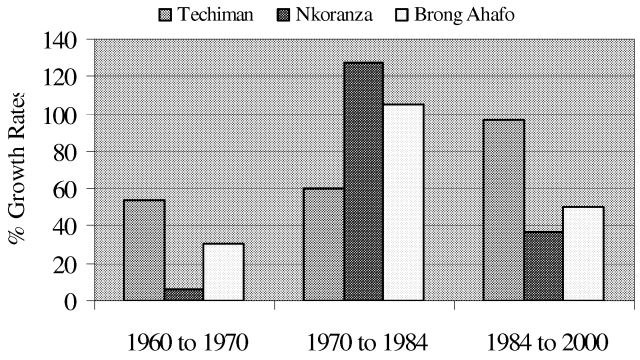
Year	District population	Population of District Capital		Rural Population		Urban Population	
		No.	%	No.	%	No.	%
1960	38,591	6,250	16.2	32341	84	6,250	16
1970	41,184	7,192	17.5	33993	83	7,191	17
1984	93,791	15,065	16.1	78726	84	15,065	16
2000	128,000	21,715	17.1	87718	69	39,282	31

Source: Author's Compilation from Ghana *Population and Housing Census,* 1984 and 2002, Ghana Statistical Service.

Figure 3.2 shows the intercensal growth in Techiman and Nkoranza. Between the 1960-1970 intercensal periods, the Nkoranza District experienced an increase of 6.7 percent. This gave an average annual growth of 6 percent during the period. The 1970-1984 intercensal period showed a dramatic increase in the district's population of about 127.7 percent but the intercensal growth between 1984 and 2000 decreased to 36.5 percent. The average annual change in population was 9.1 percent. This figure is relatively small compared to that of the Techiman District. While the intercensal growth of Techiman increased during the intercensal years that of Nkoranza and the Brong Ahafo Region declined. The out-migration from Nkoranza, which has more or less balanced the immigration of the settler farmers from the northern Ghana, may have explained this small increase in average annual population size (MTDP-NDA, 1996-2002). The population however, more than doubled within the 14 year period. The Brong Ahafo Region also experienced an intercensal growth of 30.4 percent and 105.2 percent for the periods 1960-1970 and 1970-1984 respectively.

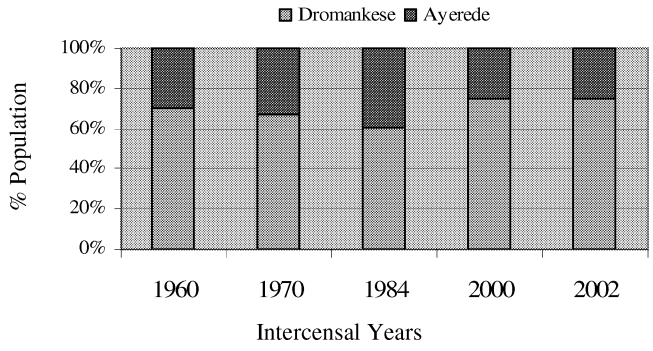
As shown in Figure 3.3, Ayerede and Dromankese were the most populated locations among villages surveyed. The population of Ayerede has been declining as compared to Dromankese. Dromankese is noted for its small-scale charcoal burning industry. Indigenous Brongs and settler farmers combine charcoal-burning with farming. Male-female ratios of the surveyed localities are shown in Figure 3.4. The mean male-female ratio was about 1.13. The highest male-female ratio of about 1.6 occurred at Woraso in the Techiman District and the lowest was at Nkwaeso also in the Techiman District with a figure of about 0.94.

Figure 3.2. Intercensal Growth in Techiman and Nkoranza Districts



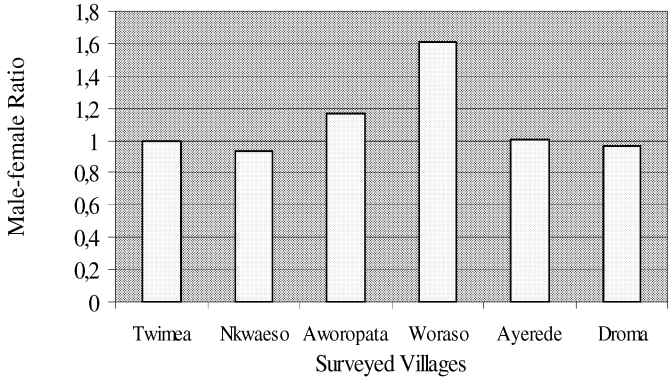
Source: Author's Compilation from Ghana *Population and Housing Census,* 1960, 1970, 1984 and 2002, Ghana Statistical Service.

Figure 3.3. Population Distribution of Some Major Settlements in Nkoranza District



Source: Author's Compilation from Ghana Population and Housing Census, 1960, 1970, 1984, and 2002, Ghana Statistical Service, MTDP-NDA (1996-2002).

Figure 3.4. Distribution of Male-Female Ratio of the Surveyed Localities

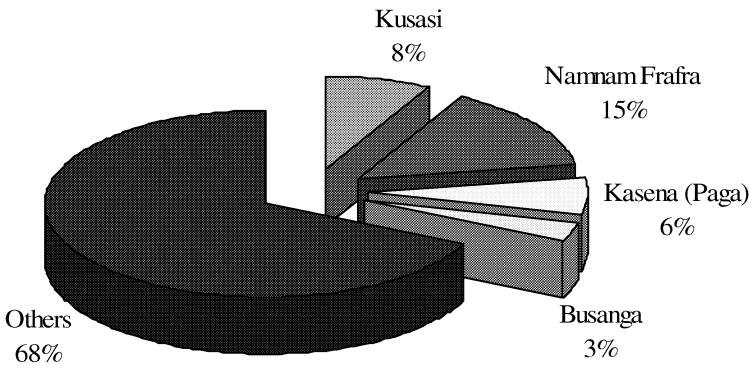


Source: Author's Compilation from Ghana *Population and Housing Census,* 2002, Ghana Statistical Service.

3.9. Sequence of Migration of Upper East Migrants in Brong Ahafo

Almost all the predominant ethnic groups from northern Ghana migrate to Techiman and Nkoranza in the Brong Ahafo Region of Ghana. Northern Ghana is mainly divided into three regions namely the Northern, Upper West and the Upper East Regions but as Figure 3.5 shows, about 32 percent of the migrant population in Techiman and Nkoranza constitutes of Upper East migrants. With the rural migration flow from the Upper East Region to the Brong Ahafo Region, the main Upper East ethnic groups involved as depicted by Table 3.6 are the Frafras from the Bolgatanga and Bongo Districts, the Busangas from the Bawku-East District, the Kasenas from the Kasena-Nankani District, the Kusasis from the Bawku-East and Bawku-West Districts and the Builsas from the Builsa District. In terms of the most immigrant ethnic groups from Upper East, the Namnam Frafras appear to be dominant in both Techiman and Nkoranza. However, for the second generation migrants, the other ethnic groups apart from Upper East migrants are more dominant in Brong Ahafo (Table 3.7).

Figure 3.5. Shares of Upper East Ethnic Groups in the Total Migrant Population in Techiman and Nkoranza of Brong Ahafo Region



Note: Others include the Bimoba and the Mamprusi from the Northern Region; Walba (Wala), Dagarte (Dagaba) and Sissala from the Upper West Region of Ghana.
Source: Author's Compilation from Ghana *Population and Housing Census*, 2002, Ghana Statistical Service.

Table 3.6. Origin of Upper East Migrants in Techiman and Nkoranza Districts

	Predominant Ethnic Groups			
District of Origin	Busanga (%)	Kusasi (%)	Kasena (%)	Namnam-Frafra (%)
Bawku-East	87	70	2	2
Bawku-West	11	28	1	1
Bolgatanga	1	2	2	69
Bongo				27
Kasena-Nakani	1		86	1
Builsa			9	

Source: Author's Compilation from Ghana *Population and Housing Census*, 2002, Ghana Statistical Service.

Table 3.7. Distribution of Ethnic Groups in Techiman and Nkoranza by Region of Birth

	Born in Brong Ahafo and Residing in Brong Ahafo			Born in Upper East but Residing in Brong Ahafo		
Ethnic Groups	Techiman (%)	Nkoranza (%)	All (%)	Techiman (%)	Nkoranza (%)	All (%)
Kusasi	6	5	6	25	10	17
Namnam Frafra	4	17	9	20	50	37
Kasena (Paga)	2	6	4	9	21	16
Busanga	3	1	3	10	3	6
Others	84	70	79	35	16	25

Note: Others include the Bimoba and the Mamprusi from the Northern Region; Walba (Wala), Dagarte (Dagaba) and Sissala from the Upper West Region of Ghana.

Source: Author's Compilation from Ghana *Population and Housing Census*, 2002, Ghana Statistical Service.

More Frafra migrant farmers have settled in the Ayerede zone and Dromankese in the Nkoranza District and in Nkwaeso in the Techiman District (Table 3.8). The Frafras in Ayerede are located at Donkro-Nkwanta and Damango. The predominantly Muslim community of Busangas are located at Twimea-Nkwanta where they combine farming with other non-farm activities like sawn wood trading and weaving of traditional northern hats as the main sources of off-farm earnings. The Kusasi migrants are fairly distributed across the sampled villages with the Woraso, Nkwaeso and Ayerede zone recording the highest. The Ayerede zone is also populated with Kasena migrant farmers. The Builsas are found in Nkwaeso and Aworopata while the Gurunshies are located at Twimea-Nkwanta, Aworopata, Ayerede and Dromankese. The Upper East migrant farm households in these locations comprise of both old and new settlers.

Table 3.8. Location of Upper East Migrants in the Sampled Villages

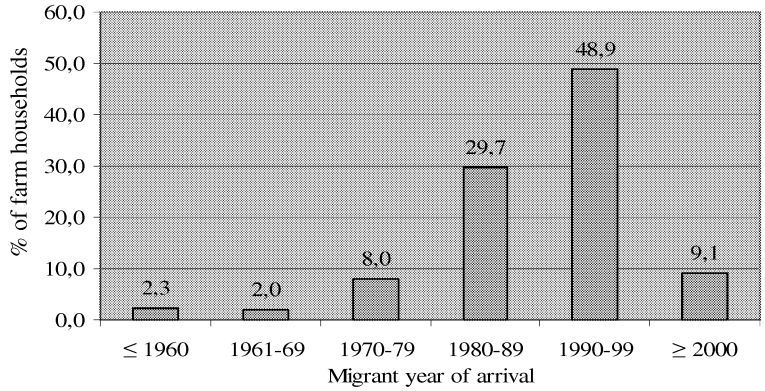
Ethnic Groups (%)	Techiman				Nkoranza	
	Twimea-Nkwanta	Nkwaeso	Woraso	Aworopata	Ayerede Zone*	Dromankese
Frafra		22	11	13	28	26
Kusasi	10	25	31	12	20	2
Busanga	80		3	6	11	
Kasena		8	12		77	3
Builsa		33		67		
Gurunshi	14			14	29	43

Note: * Ayerede zone comprises of 3 villages: Ayerede, Donkro-Nkwanta and Damango.

Source: Author's Compilation from NWO Survey (2003).

Figure 3.6 illustrates the arrival of Upper East migrant farm households in Brong Ahafo. About 13 percent of the households are very old settlers who arrived between 1960 and 1979. Generally, more of the households arrived in Nkoranza from 1980 to 1999. Recent arrivals are however very few. Table 3.9 also shows the periods of arrival of ethnic groups from Upper East in Techiman and Nkoranza. Before the 1960s, the Frafras and the Busangas were the first to settle in Techiman and Nkoranza. The 1960s saw the arrival of more Frafras and some proportions of Kusasi

Figure 3.6. Distribution of Migrant Year of Arrival



Source: Author's compilation from NWO Survey (2003).

and Kasena migrants. More Kusasis and Kasenas continued to arrive in the next decade together with some significant proportions of Frafras, Busangas and Gurunshies. The majority of Kusasis in the sampled households arrived in the 1980s together with quite a sizeable proportion of Frafras. The 1990s witnessed the arrival of almost all the ethnic groups from the Upper East Region in the Brong Ahafo Region.

Table 3.9. Order of Migration of Upper East Ethnic Groups in Brong Ahafo Region

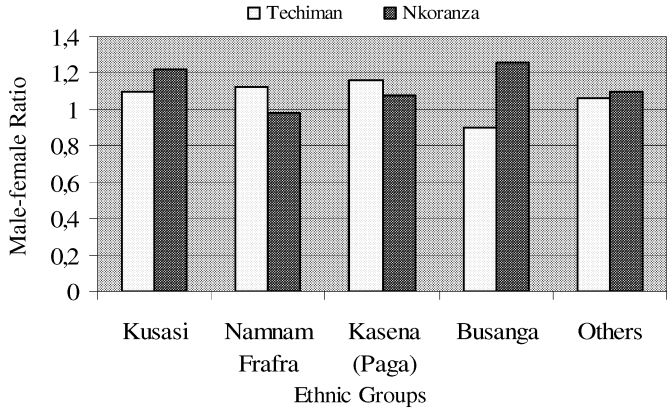
	Year of Arrival					
Ethnic Groups (%)	≤ 1960	1960-69	1970-79	1980-89	1990-99	≥ 2000
Frafra	50	57	18	27	26	13
Kusasi		29	29	35	29	42
Busanga	50		12	13	22	32
Kasena		14	29	19	13	
Builsa					3	
Gurunshi			12	6	7	13

Source: Author's compilation from NWO Survey (2003).

Again, it was during this decade that the Builsa migrants from Sandema in the Builsa District of the Upper East Region arrived in Techiman and Nkoranza. From the year 2000 onwards, the predominant ethnic groups that have been settling in Techiman and Nkoranza are the Kusasis and the Busangas. Only the Frafra migrants continued to settle during every decade in Techiman and Nkoranza from before the 1960s to the present. With the exception of the periods before the 1960s, the Kusasis continued to settle in Brong Ahafo during each decade to the present and with the exception of the 1960s, the Busanga migrants have been settling in Techiman and Nkoranza.

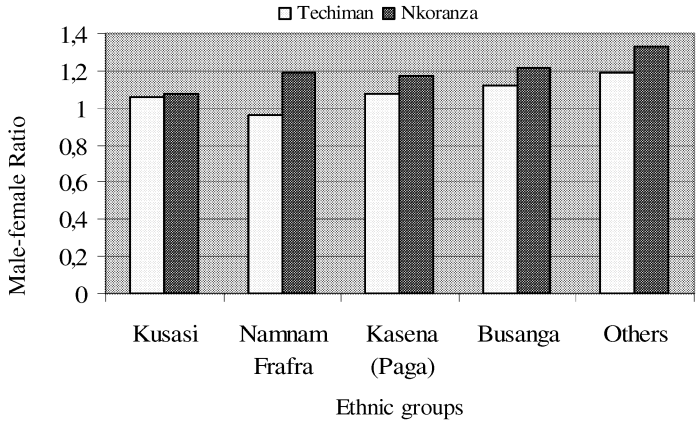
Kusasi male migrants born in Brong Ahafo appear to be more than the females in Nkoranza than in Techiman (Figure 3.7). Male Busangas exceed female Busangas in Nkoranza but not in the Techiman District. Frafra and Kasena male migrants on the other hand outnumber their female counterparts in Techiman than in Nkoranza. With the exception of Frafras in Nkoranza and Busangas in Techiman, male migrants are more than the female among all the ethnic groups from the North. The other ethnic groups from the North born and residing in Brong Ahafo include the Dagarte (Dagaba), Walba (Wala) and Sisala from the Upper West Region and the Bimoba and Mamprusi from the Northern Region of Ghana. The main occupation of the Sisala migrants in Brong Ahafo is charcoal production. The Dagartes are predominantly yam growers and pito (soghum beer) brewers (Amanor *et al*., 2002). The sex ratios of the other Northern ethnic groups in Techiman and Nkoranza are 1.06 and 1.10 respectively.

Figure 3.7. Male-Female Ratios of Ethnic Groups Born in Brong Ahafo and Residing in Brong Ahafo



Note: Others include Dagarte (Dagaba), Walba (Wala), Sisala, Bimoba and Mamprusi.
Source: Author's Compilation from Ghana *Population and Housing Census* 2002, Ghana Statistical Service.

Figure 3.8. Male-Female Ratios of Ethnic Groups Born in Upper East but Residing in Brong Ahafo



Note: Others include Dagarte (Dagaba), Walba (Wala), Sisala, Bimoba and Mamprusi.
Source: Author's Compilation from Ghana *Population and Housing Census* 2002, Ghana Statistical Service.

Among all the ethnic groups from the North, Figure 3.8 suggests higher male-female ratios in Nkoranza than in Techiman. With the exception of Frafra migrants in Techiman, all male Upper East migrants residing in Techiman and Nkoranza but born in their hometown exceed their female counterparts. Table 3.10 catalogues some of the reasons contributing to the out-migration of predominant ethnic groups from Upper East to Brong Ahafo. In general, male migrants exceed the females because the males normally arrive first before their wives and children join them after they have settled at the migrant place of destination. In some migrant households, the wives do not even join the husbands but remain at the migrant place of origin with the younger children. In that case, the women normally undertake occasional visits to the male migrants.

The environmental out-migration degradation hypothesis on the Upper East Region is amplified by the farm household survey. Poor quality land, unavailability of land and pressure on land due to increasing population growth were some of the push factors of the rural out-migration from the Upper East Region. Lack of jobs necessitated the migration of about 33 percent of the farm households.

Table 3.10. Reasons for Migrating from Upper East to Brong Ahafo

Ethnic groups (%)	Reasons for Migrating				
	Pressure on land	Poor quality land	Lack of jobs	Join parents	Escape cultural influence
Frafra	26	22	39	4	9
Kusasi	11	40	40	3	6
Busanga	9	51	20	9	2
Kasena	31	27	27	8	7
Builsa		67	33		
Gurunshi	14	14	30	14	11
Total	17	34	33	7	9

Source: Author's Compilation from NWO Survey (2003).

The geographical location of Nkoranza and Techiman in the transition zone of Brong Ahafo presents a safe haven for most rural farmers escaping the harsh environmental and economic conditions in the North. The Brong Ahafo Region is the closest region to the North and serves as the entry point to the South. The proximity and recent improvements in road networks (Abdulai, 1999) facilitate easy flow of information, goods and people between the North and the South. Table 3.11 summarises why Upper East migrant farm households settled in Brong Ahafo. The main pull factor in Techiman and Nkoranza was availability of good quality land for farming compared to Upper East (migrant access to land in the Brong Ahafo Region will be analysed in detail in Chapter 4). About 12 percent of the respondents mentioned the closeness of the Upper East Region to the Brong Ahafo Region and the easy flow of information and goods between the two regions as factors which pulled them into the Brong Ahafo Region.

Table 3.11. Reasons for Settling in Brong Ahafo Region

Activity	Districts		Total (%)
	Techiman (%)	Nkoranza (%)	
Quality and availability of land	74	56	66
Presence of commercial activities	7		4
Easy flow of information	9	15	12
Came with parents	2	4	3
Join family	6	20	12
Quality infrastructure	1	1	1
Employment opportunities	2	3	2

Source: Author's Compilation from NWO Survey (2003).

Compared to the Upper East, commercial activities exist in Brong Ahafo. The food market in Techiman for instance attracts a lot of rural migrants with commercial interests from the North into the region. Others joined their family (parents, brothers, etc.) in Brong Ahafo or came with them. Three percent migrated with parents during their first move to the Brong Ahafo and 12 percent joined their family later. The

traditional migration flow has been for the head to embark on the migration, get settled at the place of destination before the family and other members of the extended family could join him.

3.10. Summary and Conclusions

In this Chapter, the agro-ecology and agricultural activities of Upper East and Brong Ahafo have been described. The order of migration and migration dynamics from the Upper East to Brong Ahafo has also been described. Whilst the Upper East experiences warm, and dry, dusty harmattan air mass and monsoon air mass, Brong Ahafo has more moderate temperatures. Brong Ahafo has both the savannah and forest vegetation but in the Upper East, only the savannah vegetation exists with soils whose productivities have declined due to high temperatures and unfavourable moisture regime. Compared to the forest soils in Brong Ahafo, the soils in the Upper East are characterised by rapid soil decomposition rates, and lower organic matter and nutrient status. The Upper East Region has a unimodal rainfall but Brong Ahafo Region has bimodal annual rainfall.

The annual bimodal rainfall in Brong Ahafo supports two cropping seasons and about 70 percent of the population is engaged in agriculture. The main food crops cultivated are maize, yam, cassava and plantain. Cassava and maize are grown all over the Brong Ahafo Region. The Brong Ahafo Region is the third largest producer of cocoa after the Western Region and the Ashanti Region in Ghana. The main livestock from the region are goats, cattle and poultry. In Upper East, only one cropping season exists because of the unimodal rainfall pattern. Agriculture in the Upper East Region is mostly mixed farming. Food crops are mostly planted on compound farms, intermediate and bush farms. Major food crops grown in the region are rice, maize, soybeans, sorghum, millet and groundnut. Cotton has also become one of the major cash crops grown in the region. Cattle, goats and sheep are some of the livestock kept in the Upper East Region.

The Chapter points out that the population of Techiman and Nkoranza have seen consistent increases since 1960 to 2000 due to the influx of settler farmers from the North. The main ethnic groups involved in the rural-rural migration flow from the Upper East Region to the Brong Ahafo Region are the Frafras from Bolgatanga and the Bongo Districts, the Busangas from the Bawku-East District, the Kasenas from the Kasena-Nankani District, the Kusasis from the Bawku-East and Bawku-West Districts and the Builsas from the Builsa District. In addition to the Namnam Frafras who are the most dominant Upper East ethnic group and who were the first to settle in the Techiman and Nkoranza Districts, the Busangas were also among the early settlers. Apart from very old settlers who arrived between 1960 and 1979, the study found few recent arrivals and that most of the Upper East migrant farm households started to arrive in Nkoranza and Techiman from 1980 to 1999. The mean male-female ratio of the surveyed localities in Brong Ahafo was about 1.13. The highest male-female ratio of about 1.6 occurred at Woraso in the Techiman District and the

lowest ratio of 0.94 occurred at Nkwaeso also in the Techiman District. The male migrants exceed the females because they arrive first before their wives and children join them. In addition to the most cited phenomena such as availability of good quality land for farming and the presence of commercial activities in the Brong Ahafo Region, the study found the closeness of Upper East to Brong Ahafo and easy flow of information and goods as some of the potential pull factors which contribute to the rural-rural migration flow between the Upper East and Brong Ahafo Regions of Ghana.

In the next Chapter, land acquisition by Upper East migrant farm households is examined. Subsequent Chapters investigate their on-farm and off-farm income generation, remittances and the implications of their agricultural activities for the environment.

Chapter 4

Land Acquisition

In terms of land area cultivated, tenancy is an institution of major and increasing importance in the Brong Ahafo Region. For settler farmers from the Upper East Region, tenancy contracts represent an integral part of their economic opportunities. Lands available for tenancy contracts in Brong Ahafo include the virgin forest (uncultivated forest), savanna (grasslands), woodland and taungya (forest reserve land). The chiefs are custodians of virgin forests. Farming in forest reserves occurs when land is in serious short supply. Opening up forests for cultivation and tilling of savannah soils such as ploughing and construction of ridges and mounds require much labour input. To access land for farming, settler farmers must first seek permission from the chief in whose locality they wish to farm. If permission is granted, they may contact landowners to access land on contractual basis.

Different tenurial arrangements coexist in the Brong Ahafo Region but the fixed-rent and sharecropping contracts are the most common. The different tenure contracts go hand in hand with different entrepreneurial abilities of the farm household (Hallagan, 1978). To access fixed-rent plots, tenants must make cash payments upfront, which requires liquidity. Due to credit market imperfections (Bliss and Stern, 1981; Jaynes, 1982) landless tenants lack the necessary collateral such as owned land to access credit (Binswanger and Rosenzweig, 1983). Liquidity constraints and entrepreneurial abilities therefore act as screening devices for the farm households in their attempt to access the various tenancy contracts in Brong Ahafo. Moreover, any policy direction that increases the profitability of agriculture, such as changes in the wages to hired farm labour and prices of other inputs or outputs have the tendency to affect the farm household's acreage decision under tenancy contracts.

The main objective of this Chapter is to analyse the acquisition of land by Upper East migrant farm households in Brong Ahafo. The Chapter is laid out as follows. The rules and customs concerning land acquisition in the Brong Ahafo Region are provided in Section 1. In Section 2, the institutional land tenure arrangements are examined. A preview of the literature is undertaken on the choice of tenancy contracts in Section 3. Section 4 explains renting-out and renting-in of plots between landowners and tenants. Input intensities and yields on rented and owner-cultivated plots are also explored here. A theoretical model on land area cultivated under tenancy contracts is formulated in Section 5. The model examines the optimisation behaviour of landless tenants and owner-cultivators who have entered into fixed-rent and sharecropping contracts. It offers an explanation on demand and supply of rented land, and labour allocation decisions on rented and owner-cultivated plots. To quantify the effects of the determinants of the area cultivated under fixed-rent and sharecropping contracts, an empirical model is specified in Section 6. The area

cultivated under fixed-rent or sharecropping contract is censored because of possible zero observations. Moreover explanatory variables of area cultivated under tenancy contracts such as liquid wealth and off-farm income are potential endogenous variables which need to be corrected for simultaneity bias. Hence the two-step instrumental variables (IV) technique suggested by Nelson and Olson (1978) and Newey (1987) is employed in the estimation of the empirical model. Conclusions are distilled in Section 7.

4.1. Rules and Customs on Land Acquisition

The indigenous Brongs are the original owners of land in the Brong Ahafo Region. The paternal and maternal systems of land inheritance are very prevalent in the Techiman and Nkoranza Districts. These are family lands on which over the years families have claimed ownership rights through constant cultivation and thus hold exclusive rights to pass on such lands through inheritance. In the Upper East Region, the chiefs are perceived to be the first settlers or *tendamba*. They hold allodial title to execute judicial, governance and land management functions. The customary land tenure system in Ghana, however, has been undergoing tremendous change and evolution. In the North, the system of inheritance and succession to property is patrilineal but the matrilineal system is more prevalent among Akan speaking areas in the South. Institutions of land tenure are now evolving towards individualised ownership through investment in tree planting and management, influx of settler farmers, inter-vivo transfer of land as gifts and grants, and the coming into effect of the Intestate Succession Law (PNDC 111) in 1985 (Kasanga and Kotey, 2001).

Indigenous landowners rent-out portions of their land holdings to settler farmers through various forms of tenurial arrangements. The virgin forests are common resource at the village level. Because of the substantial labour input, those who clear such forests are given strong rights. Individualisation of landownership in the Akan matrilineal communities has been strengthened by the Intestate Succession Law (PNDCL 111) 1985 (Kasanga and Kotey, 2001). Before the promulgation of this law, family heads used to bequeath land to nephews and other members of the extended family leaving wives and children with no property if the man were to die intestate. The Intestate Succession Law is a legal framework that provides equal rights of inheritance between spouses and increased rights for children. The law focuses on properties that have not been covered by a will and also puts emphasis on the importance of the nuclear family. It states that irrespective of class, marriage type and lineage, there should be a uniform intestate succession system applicable throughout the country. It also aims at bequeathing a large proportion of the property of the deceased to his/her spouse and children in a manner that was not previously adhered to under the customary traditional laws. Otsuka *et al.* (1998) have observed that instead of the stipulations of the law, some local communities prefer a formula that gives one-third of the property to each spouse, children and maternal family.

Certain taboos formulated as laws are used to protect forestlands. In Aworopata and Woraso, it is a taboo to visit the forest farms on Thursdays. Failure to comply with this directive attracts sanctions such as payment of fines (drinks, sheep or goat) to the local chief or community leader to pacify the gods. It is believed that a mythical snake supposed to be the forest god bites recalcitrant farmers who flout this rule and enter the forest on forbidden days. The local chiefs use such redundant farming days to mobilise the people in the locality for communal labour such as clean-up exercise, clearing of surrounding bush and community building projects.

4.2 Tenure Arrangements

Land rental markets are very active in the Brong Ahafo Region. There is coexistence of several tenancy contracts in the Techiman and Nkoranza Districts but the fixed-rent and sharecropping contracts were most common among Upper East migrant farm households. In addition to these, one occasionally encounters tenure arrangements such as grants, gifts and the taungya system (farming in the forest reserve). Table 4.1 summarises the incidence of different tenurial arrangements on migrants' plots. Farm households may have one or more plots of the same or different tenurial arrangements. The features of these tenancy contracts are described in detail in the Sections that follow.

4.2.1 Fixed-Rent Contracts

A fixed-rent contract is a land tenure arrangement in which the landowner hires out or leases part of his land to a tenant for a specific amount and stipulated duration. The rent is fixed in advance independent of the tenant's output. The central feature of the contract is that tenants are completely autonomous in terms of labour and purchased inputs such as fertiliser, seeds, chemicals, etc. Within the category of fixed-rent contracts, one can distinguish two types. One in which tenants make upfront cash payments to landowners and the other, where tenants pay the rent in-kind after the harvest. The latter was found among households in Ayerede, Donkro-Nkwanta and Damango in the Nkoranza District. The fixed-rent in-kind arrangement permits tenants to access an acre of land for maize cultivation for one season but pay a *bag of maize* after harvesting. Tenure on such plots is renegotiable at the end of the cropping season. As indicated in Table 4.1, fixed-rent contracts were more common among the farm households in Nkoranza than in Techiman. Cash fixed-rent contracts exceeded in-kind fixed-rent in Nkoranza. The duration of the contract is one year or more depending on the rental rate. Hiring of land for monetary rents becomes more common as land becomes scarcer. As land becomes scarce, leasing tends to become more attractive to migrant farmers. Hiring on already stumped lands attracts a premium from landowners because of the high labour input in stumping (Amanor *et al.*, 2002).

Rental rates for fixed-rent plots depend on tenure duration, plot size and the nature of vegetation. Fixed-rental rates are higher in Techiman than in Nkoranza. Proportion of plots under the prevailing rates for cash fixed-rent contracts in 2003 are shown in Table 4.2. Rental rates for forest plots are between ¢200,000 and ¢300,000

Table 4.1. Distribution of Tenure Contracts

	District		Brong Ahafo
Tenancy Type	Techiman (%)	Nkoranza (%)	Region (%)
Sharecropping	33	15	27
Fixed-rent	31	77	47
fixed-rent (in-kind)		26	9
fixed-rent (cash)	31	51	38
Taungya	22		15
Gift	4	4	4
Grant	10	4	7
Purchased		1	

Source: Author's Compilation from NWO Survey (2003).

per acre per year. Few tenants could afford the rates probably due to liquidity constraints. Tenants rented grassland or savannah plots within the range of ¢50,000 - ¢100,000 per acre per year under cash fixed-rent. According to Hayami and Otsuka (1993), tenants in fixed-rent contracts have full incentives but liquidity constraints reduce demand for the contract.

Table 4. 2. Distribution of Rental Rates for Cash Fixed-Rent Contracts

Rental Rates (β)	District		Brong Ahafo
(¢/acre/year)	Techiman (%)	Nkoranza (%)	Region (%)
$\beta \leq 50000$	11	15	12
$50000 < \beta \leq 90000$	10	14	11
$90000 < \beta \leq 100000$	5	13	8
$100000 < \beta \leq 200000$	4	5	4
$200000 < \beta \leq 300000$	1	4	3
Total	31	51	38

Note: ¢ = Ghanaian Cedis. Exchange rate: US$1=¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

4.2.2 Sharecropping Contracts

In sharecropping contracts, the rent is paid from the share of the output produced from the rented land. The tenant pays no explicit fixed cash to the owner. The landowner and the tenant choose between the standardised type of sharecropping contracts in Techiman and Nkoranza known as the *abusa* and the *abunu*. With the *abusa* system, the landowner retains a third whilst the tenant retains two-thirds of the output. Both parties in the *abunu* system retain a half of the output. The *abusa* system of sharecropping was developed in Southern Ghana during the economic depressions of the 1930s, when farmers had difficulty in paying the wages of labourers in cash (Austin, 1987). Work on sharecropping in 1956 by Polly Hill threw more light on labour arrangements between labourers and owners in the Ghanaian cocoa industry. Hill (1956) identified the *abusa* system as the dominant form of labour relationship.

The incidence of sharecropping in Techiman was higher than in Nkoranza (Table 4.1). An important characteristic of sharecropping contracts in the surveyed villages was that tenants were autonomous in terms of inputs on rented plots. Few occurrences where landowners shared the cost of inputs with the tenants, the *abunu* system was preferred.[1] No specific tenure duration was observed on sharecropped plots in Techiman and Nkoranza. Migrant sharecroppers who cultivated plots on which landowners had already planted trees like teak or cashew had no option but to vacate the plots since food crop production becomes impossible when trees reach maturity.

4.2.3 Grant and Gift Plots

Recipients of grant plots had no specific tenure duration. Free-entry into already cultivated savanna or grassland plots was permitted in Dromankese in Nkoranza but not in any of the villages in Techiman which reflects a high proportion of migrant influx in Techiman. In Dromankese, settlers could access free plots if no crops had been cultivated at the time of entry. Users of such community lands have no user rights so they only have to make annual or occasional contributions in-kind or in-cash to the local chief or the community leader. Migrants sometimes receive plots as gifts, either from friends or from indigenous landowners for whom they have worked for a long time as hired labourers. Outright purchase of land for farming was not common among Upper East migrant farm households in Techiman and Nkoranza. Indigenous landowners do not normally sell their land unless forced by extremely difficult

[1] Otsuka and Quisumbing (2001) observed in Southern Ghana that ownership not the produce is divided when trees are planted on sharecropping plots. In India where landowners often share the cost of purchased inputs (fertiliser and chemicals) with tenants, output is shared at the same rate as the cost of inputs (Nabi 1986).

circumstances. According to Bardhan (1984), land prices do not fully compensate for high risks in parting with such secure assets.

4.2.4. The Taungya System

Taungya is another form of tenure arrangements for landless tenants in the Brong Ahafo Region. The system permits settler farmers to cultivate food crops in designated forest reserves. In return, the tenants plant trees under the supervision of the Forest Service Division of the Ministry of Land and Forestry in Ghana. The Office of the President in accordance with the 1962 Concessions Act, administers all trees in Ghana on behalf of chiefs who are the allodial authority (Kasanga and Kotey, 2001; Amanor *et al*., 2002). This gives the Ghana Forestry Service control over all trees (particularly timber trees) whether in the forest reserves or on farmers' fields. Farmers have no right to any royalty payments but royalties are paid to chiefs, the stool and to the district authorities. Farming on taungya plots in the forest reserve by settler farmers has increased because of scarcity of land. Taungya tenants freely undertake food and cash crop production in the forest reserve but are under obligation to maintain and nurture the trees.

The taungya system was copied from Southeast Asia (FAO, 1997) at the beginning of the 20th century and is used in most forest plantations as a means of improving Ghana's forest. The proportion of farm households in Techiman with taungya plots is shown in Table 4.1. In Techiman the households had other plots apart from taungya but no taungya contract was recorded among the migrant farm households in Nkoranza. In Aworopata and Woraso, taungya plots were located in the Asubima Forest Reserve, which covers about 5 percent of the total land area of the Techiman District. The mean taungya acreage in Techiman was about 0.42 acres with a range of 1-4 acres per household. In other parts of West Africa especially in Nigeria where the system was widely practised, the total area of traditional taungya farms was about 22,800 acres in 1979 (Ball and Umeh, 1981).

4.3. Choice of Tenancy Contracts

Various reasons on the choice of tenancy have been given in the literature but the most cited phenomena are asymmetric information (Hallagan, 1978), provision of non-tradable inputs (Eswaran and Kotwal, 1985), efficiency of one contract over the other (Marshall, 1890; Bell, 1977; Shaban, 1987) and risk considerations (Stiglitz, 1974). Wage contracts (owner-cultivation) and rent contracts (fixed-rent and sharecropping) can co-exist in the same area in particular when crops differ in their need for non-traded inputs such as labour supervision. Provision of non-tradable inputs as noted by Eswaran and Kotwal (1985) creates an opportunity for tenants and owners to enter into sharecropping contracts. While tenants are often better endowed

with access to cheap labour and supervisory skills, owners tend to have better access to market information that can provide better management skills. The capital constrained landowners and capital holding tenants could both gain by entering into sharecropping contracts (Jaynes, 1982).

Cheung (1969) has argued that under certainty and if transaction costs are the same for all contracts then a share contract that specifies the labour supply of the tenant could lead to the same efficient allocation of resources as fixed-rent or wage contract. If both contracts have lower transaction costs, sharecropping would not be observed. The work incentive of a sharecropping tenant is weak because only a fraction of the residual profit accrues to him. This is the Marshallian inefficiency thesis of sharecropping contracts. The fixed-rent tenant on the other hand, receives all benefit from extra effort so incentives under fixed-rents tend to be better than sharecropping. If sharecropping is to be chosen, it must have transactional efficiency not possessed by fixed-rent contracts.[2] Moreover, sharecropping contracts have the advantage of allowing risk to be shared between the owner and the tenant whereas with fixed-rent contracts or owner-cultivation, the tenant or the owner bears all the respective risks. Under the assumption of no enforcement cost, the risk-sharing properties of sharecropping can be attained with mixtures of fixed-rent and owner-cultivation (Stiglitz, 1974; Newbery, 1977).

Different tenure arrangements correspond with different levels of management (Hallagan, 1978) and the choice between sharecropping and fixed-rent contracts is more closely tied to the provision of entrepreneurial abilities of the parties involved in the tenancy contract (Rao, 1971). Entrepreneurial abilities are needed for tenants to enter into rent contracts with owners. Migrant tenants with lower entrepreneurial abilities will offer themselves as casual labourers to owners in owner-cultivation. The semi-endowed tenants will enter into sharecropping contracts. When the alternative of sharecropping is cash fixed-rent, sharecropping will continue to rise. Presumably, younger tenants with less knowledge would rather sharecrop than enter into fixed-rent contracts. Tenants whose abilities are so low that their output is insufficient to cover both the opportunity cost of the owner's land and their own labour could either become casual labourers or tenants, but would default, and move to another location (Murrell, 1983). Tenants with higher incomes and relatively higher entrepreneurial abilities will sign fixed-rent contracts with landowners. Landowners with high initial endowments will maximise their income by hiring-in casual labourers in owner-cultivation. The intermediate endowed owners will offer sharecropping contracts to tenants. Those without any initial endowment will enter into fixed-rent contracts with much endowed migrant tenants.

[2] The use of share contracts can be optimal when direct enforcement mechanisms are unavailable (Allen 1985).

4.4. Renting-Out and Renting-In Plots

Landowners could self-cultivate by hiring-in casual labourers in owner-cultivation or rent-out land to landless tenants under the existing tenure contracts. Plausible conditions must exist for transfer of plots between owners and tenants. The objective of this Section is to discuss some of the constraints tenants face in renting-in land and explain why landowners rent-out land to tenants rather than self-cultivation. Yields and input intensities on rented and owner-cultivated plots are also explained.

4.4.1. Renting-Out Plots

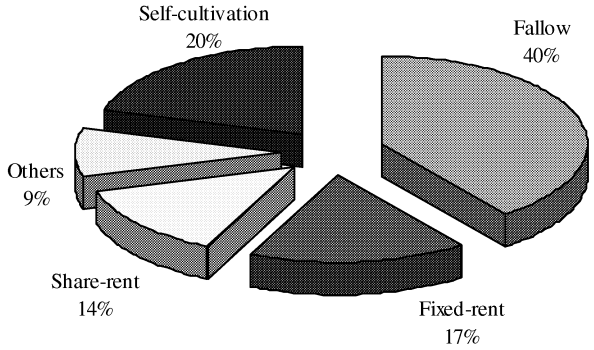
Self-cultivation or supply of land to tenants by landowners is based on the economic incentives from the tenancy contracts. Renting-out land is probably an economically more viable option than to manage large landholdings (Binswanger and Rosenzweig, 1986). Farm households have limited access to working capital (Eswaran and Kotwal, 1986) therefore liquidity is very crucial in agricultural production. Apart from cash for family consumption within the seasonal cultivation period, liquidity is required for employing the services of hired labour, renting of equipment and purchasing variable inputs such as improved seeds, fertiliser and other chemicals (weedicides and pesticides). When landowners have liquidity necessary to enter into farming, the tendency is for them to self-cultivate but those with less working capital are likely to rent-out the rest of their land (Sadoulet *et al*., 2001). Those with small land holdings and less liquidity to self-cultivate are likely to rent-out all their plots to landless tenants with sufficient working capital.

Supervision and monitoring costs on hired farm labour could also affect the owner's willingness to rent-out plots to tenants. Landowners with limited labour for supervision of hired farm labour due to old age and absenteeism (especially children) will find it optimal to rent-out land than to self-cultivate. Those engaged in activities other than cultivation are likely to rent-out their plots. Where markets are absent and undeveloped, landowners are expected to release more land for sharecropping (Eswaran and Kotwal, 1985). Risk-averse landowners and tenants are likely to opt for sharecropping contracts as a source of insurance (Stiglitz, 1974; Otsuka and Hayami, 1988) if there is no access to good risk-coping instruments such as flexible credit and mutual insurance. Landowners tend to sharecrop with tenants in the cultivation of highly labour intensive crops. The more labour intensive the crop is, the greater the premium placed on supervision (Reid, 1976). Landowners would prefer to sharecrop with less risk-averse (wealthy) households that have access to sources of insurance such as secure off-farm incomes.

Figure 4.1 gives a distribution of owner-cultivated plots in Techiman and Nkoranza. Plots rented-out by owner-cultivators to tenants under fixed-rent contracts exceed cropshare plots. The proportion of plots under self-cultivation is rather higher

than plots rented-out to tenants under fixed-rent contracts. Larger proportions of the landholdings were under fallow. Landowners in Brong Ahafo periodically put their plots to fallow to allow the soil's fertility to regenerate.

Figure 4.1. Distribution of Landholdings by Owner-Cultivators



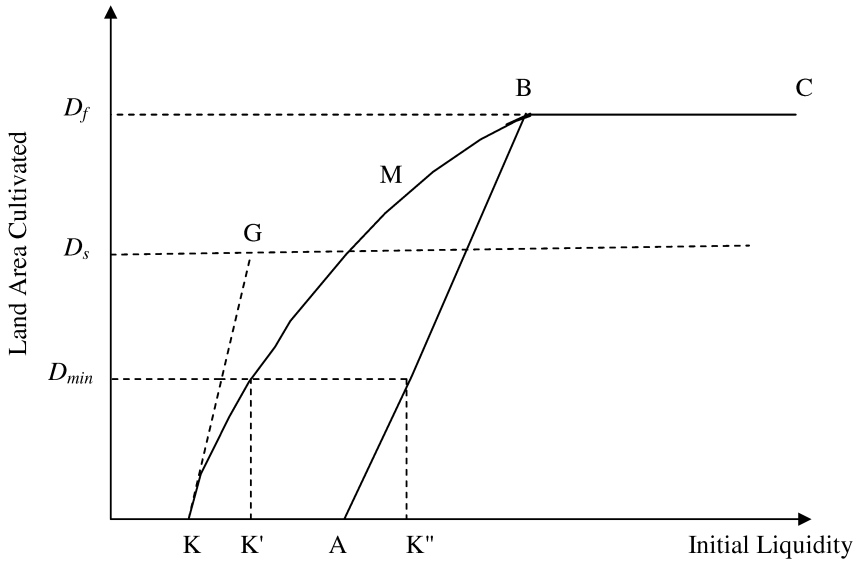
Note: Others include tenancy contracts under gift and grants.
Source: Author's Compilation from NWO Survey (2003).

4.4.2. Renting-In Plots

Renting-in land for farming at the migrant place of destination is one of the opportunities available to tenants. Those who wish to access fixed-rent plots need liquidity to pay upfront cash to owners. Cash constraints may explain why multiple contracts exist, as tenants who cannot pay cash rents will be forced to look for alternatives such as sharecropping or wage contract. Provided alternative employment opportunities exist, tenants could participate in off-farm work to generate the necessary off-farm income to reduce cash constraints.

Following similar analytical framework by Sadoulet *et al.* (2001), the effect of liquidity constraints on land area cultivated under fixed-rent and sharecropping contracts by migrant tenants is explained in Figure 4.2.

Figure 4.2. Liquidity Constraints and Area Cultivated Under Rent Contracts



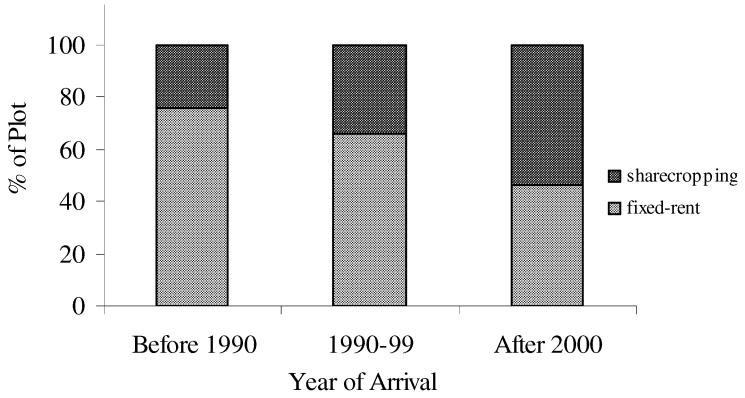
Tenants require initial liquidity (K) to enter into farming under the existing tenancy contracts. In sharecropping contracts, tenants require lower liquidity (K') since output share is differed to the end of the harvest and cash is only needed for farm operations when the farmer wants to purchase variable inputs (fertiliser, chemicals etc) and hire-in labour. Apart from the costs of variable inputs and labour, fixed-rent tenants most often make upfront cash payments for fixed-rent plots so they require higher initial liquidity (K"). If the fixed-rent is not the flat rate type but one in which rent is paid in-kind after the harvest, the minimum liquidity required to enter into such contract will be equivalent to that of sharecropping.

As the working capital of the migrant tenant increases, the land area cultivated by the sharecropping tenant increases along the curve KMB and that of the fixed-rent tenant increases faster along the line AB. The share parameter is exogenously fixed and the area cultivated by the sharecropper (D_S) is assumed to be lower than that of the fixed rent tenant (D_F). At B, liquidity constraint is no longer binding and the contract reverts to the fixed-rent. When liquidity is a binding constraint as indicated by the line KG, the landowner would decide on the land to be rented-out to the tenant so that he can utilise his available liquidity.

Recent migrants who lack working capital to set up own farms may often shuttle between the migrant place of origin and destination as seasonal migrants before they overcome liquidity constraints. The duration of stay at the migrant place of

destination allows landless tenants to accumulate enough liquidity to enter into cultivation. Figure 4.3 provides evidence on how duration of stay at the destination influences the proportion of rented-in plots. The figure reveals the coexistence of fixed-rent and sharecropping contracts in the Techiman and Nkoranza Districts of the

Figure 4.3. Distribution of Plots and Migrant Year of Arrival



Source: Author's Compilation from NWO Survey (2003).

Brong Ahafo Region. The percentage of fixed-rent plots of early settlers is higher than sharecropped plots. Recent migrants (those arriving after 2000) have a greater percentage of sharecropping plots. As the length of stay increases, the farm households may accumulate enough liquidity and managerial abilities thus enabling them to rent-in more fixed-rent plots than sharecropping plots. As the working capital increases, cropshare and fixed-rent acreages increase (Sadoulet *et al.*, 2001). Generally, recent migrants tend to cultivate more sharecropped plots than older migrant farmers thus supporting the agricultural ladder hypothesis that tenants progress from wage labour to sharecropping and then to fixed-rent as they gain both physical and human capital.

4.4.3. Yields and Input Intensities

There were differences in yields and input use on plots operated under rent contracts and owner-cultivation. Median yields and input intensities on rented and owner-cultivated plots are presented in Table 4.3. Hired and family labour inputs on fixed-rent plots were higher than cropshare plots. Hired labour use by owners exceeded that of tenants with fixed-rent plots but was below sharecropped plots. Tenants with fixed-rent and sharecropping plots employed more family labour than owners in self-cultivation. High labour use must however be balanced against the Marshallian

disincentive, which reduces the incentive of tenants to apply more labour on the farm. If the share of labour in production is high, sharecroppers will be willing to apply more labour on-farm than tenants in fixed-rent contract.

Table 4.3. Median Input Use and Yields on Rented and Owner-Cultivated Plots

Variables	Fixed-Rent	Share-Rent	Taungya	Others†	Owners	All Plots
Hired labour	25	18	23	11	23	22
(person-days/acre)	(42)	(31)	(15)	(42)	(27)	(33)
Family labour	33	21	8	15	12	20
(person-days/acre)	(73)	(45)	(63)	(36)	(15)	(55)
Fertiliser	27	28	15	52	26	27
(kg/acre)	(35)	(38)	(13)	(58)	(99)	(73)
Value of seed	79	13	160	21	83	46
(¢/acre)	(344)	(84)	(176)	(75)	(199)	(222)
Value of	55	33	55	64	65	55
chemicals (¢/acre)	(114)	(18)	(20)	(50)	(109)	(995)
Value of output	755	402	503	352	823	654
(¢/acre)	(1023)	(607)	(25300)	(350)	(4644)	(8617)

Note: †Others include grant and gift plots; figures in parenthesis are standard deviations. Value of seed, chemicals and output are in thousands Ghanaian Cedis (¢). Exchange rate: US$1=¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

Land productivity will increase if a farmer applies more purchased inputs. Owners used more chemicals (weedicides and pesticides) and seeds (improved seeds for maize, groundnut and planting materials for yam, cassava) in self-cultivation than tenants operating rented plots. The value of seeds on taungya plots in Techiman was excessively high but not much variation occurred in fertiliser use on all plots.

Output per acre on owner-cultivated plots was higher than on rented plots. Yields from sharecropped plots were lower than fixed-rent plots. The observation appears to lend support to the Marshallian inefficiency theory that output sharing discourages work effort, resulting in suboptimum. If the tenant's work effort can be costlessly observed and enforced by landowners, resource allocation under sharecropping can be as efficient as under owner-cultivation and fixed-rent contract (Adams and Rask, 1968; Rao, 1971). The differences in yield per unit of land between sharecropping and owner-cultivation or fixed-rent contract as noted by Otsuka *et al.* (1992) may depend on the direct elasticities of substitution among inputs. Gavian and Ehui (1999) also found in Ethiopia that the total factor productivity was lower on rented plots than owner-cultivated plots but inputs use were similar. They did not however provide any statistical test to control for factors that might have caused the measured differences in the production efficiencies. Bell (1977) and Shaban (1987) tested the Marshallian inefficiency hypothesis empirically by comparing the output and inputs between

owned and sharecropped plots on the same farms. However, production efficiencies between sharecropping and fixed-rent contracts were not compared. The differences in yields and input intensities from the sampled farm households in Techiman and Nkoranza may stem from farm household characteristics such as differences in initial endowments, tenure status and plot-level characteristics that affect plot quality.

4.5. Modelling Land Area Cultivated under Tenancy

In the current model, areas cultivated under rent contracts (fixed-rent and sharecropping) and owner-cultivation are formulated in one theoretical framework. This is achieved by examining the optimisation problems of tenants and owner-cultivators in fixed-rent and sharecropping contracts. The optimising behaviour of owner-cultivators aims at investigating whether it is economically viable for them to self-cultivate or enter into rent contracts with tenants.

Let us assume a farm household that derives its utility from consumption expenditures and leisure. If its utility function is monotonic, twice differentiable and strictly concave, the utility function can be stated as:

$$U = U(C_i, L_i^L;\ \psi_i),\ \partial U/\partial C > 0 \quad \partial U/\partial L > 0 \quad \partial^2 U/\partial C^2 < 0 \tag{4.1}$$

where C denotes consumption, p_C prices of goods consumed and ψ_i vector of tenant and owner household characteristics.

Consider an owner-cultivator endowed with landholding $\overline{D}$. If he rents-out part of his land D to a migrant tenant under a fixed-rent or sharecropping contract, then what is left for self-cultivation is $\overline{D} - D$. A number of simplifying assumptions are made in the model for tractability. Risk considerations are excluded, and the model is restricted to one period analysis.[3] There is no cost sharing and tenants are assumed to be autonomous in terms of variable inputs (labour and purchased) on rented plots.[4] The tenants $(i = T)$ and owner-cultivator $(i = L)$ use variable inputs X_i such as fertiliser, improved seeds, etc on the farm. Purchased prices of those inputs are denoted by p_{Xi}.

The farm household's time endowment L_i is allocated among leisure L_i^L, on-farm work L_i^F and off-farm (market) work L_i^N. Because of the seasonal nature of

[3] Bardhan (1984) and Eswaran and Kotwal (1985) considered two period models in which a discount factor per crop period was introduced in the utility maximisation problem of the farmer.
[4] This contrast with the cost sharing models under sharecropping such as the Braverman-Stiglitz model (1982) in which landowners subsidised inputs at the margins.

agricultural production, the households cannot base their farm operations on family (or own) labour alone. The households then employ the services of hired labour L_i^H on the farm during peak seasons to complement family (or own) labour to perform specific tasks such as weeding, stumping, mounding, sowing, and harvesting. Hired labour is casual and either engaged on daily or contractual basis where wage rate w_i^H is paid. Tenants and owner-cultivators undertake supervision on hired farm labour to ensure quality effort. However, owner-cultivators do not incur monitoring costs on the tenant's plot but on their own plots because of the tenant's autonomy. Supervision cost s_i on hired farm labour can be decomposed into supervision cash cost $s_i^{CC} L_i^H$ and supervision time cost $s_i^{TC} L_i^H$ but if family (or own) labour is used in supervision, then supervision cash cost becomes zero $(s_i^{CC} L_i^H = 0)$.

Tenants and owners require liquidity K_i as working capital to enter into farming. Tenants use liquidity for upfront cash payment in fixed-rent contracts. In the production process of farmers, liquidity is needed for purchasing variable inputs and labour. Credit markets for farmers are limited because of imperfect functioning markets. Liquid wealth from poultry (fowls, ducks and guinea fowls) and livestock (cattle, sheep and goats) are used in overcoming cash constraints. Farm households that participate in off-farm work could generate the necessary off-farm income to reduce liquidity constraints. Such households sell their labour for off-farm employment at the market wage rate w_i^N and use fraction σ_i of the off-farm income to finance farm activities. The market wage rate according to Huffman (1997) is determined by the wage offer equation:

$$w^N = w\left(A, E, M^C, H^C\right) \tag{4.2}$$

where age (A) and education (E) represent the skills and experience of farmer, M^C denotes market characteristics and H^C represents other household characteristics.

The farm households derive their income from three sources. Income from the farm Y_i^F, income from off-farm employment Y_i^N, and non-labour income $\overline{Y_i}$ from remittances, gifts, donations and for owners, income from rented-out land.

In fixed-rent contract, the tenant pays a fixed lump sum to the landowner. It is assumed that the lump sum β (¢/acre/year) is paid in advance to the owner before the rental contract takes effect. The tenant's production function is expressed as $f(D, L_T^F, L_T^H, X_T; z_T)$. Uncertainty is excluded from the production function and constant returns to scale is assumed as it is in most tenancy models (Otsuka *et al.*, 1992).

The farm returns of the fixed-rent tenants are expressed as:

$$Y_T^F = pf(D, L_T^F, L_T^H, X_T; z_T) - \beta D \tag{4.3}$$

where p is the product price, z_T denotes farm characteristics such as the number of years rented plot has been cultivated and/or fallowed, etc.

The fixed-rent tenant maximises utility subject to time, budget, liquidity and non-negativity constraint. His optimisation problem is stated as:

$$\begin{aligned} &\underset{V^*}{Max}\ U = U(C_T, L_T^L; \psi_T) \\ &\text{subject to} \\ &\text{Time constraint, } L_T = L_T^F + L_T^N + L_T^L + s_T^{TC} L_T^H \\ &\text{Budget constraint, } pf(D, L_T^F, L_T^H, X_T; z_T) - \beta D - p_{XT} X_T - \\ &\qquad w_T^H L_T^H + \sigma w_T^N L_T^N + \overline{Y_T} + K_T - p_{CT} C_T \geq 0 \\ &\text{Liquidity constraint, } P_{XT} X_T + w_T^H L_T^H + \beta D - \sigma_T w_T^N L_T^N < K_T \\ &\text{Non-negativity constraints, } D,\ X_T, K_T, L_T^F, L_T^H, L_T^N, L_T^L, \sigma_T \geq 0 \end{aligned} \tag{4.4}$$

The vector of decision variables, $V' = (D, X_T, L_T^F, L_T^H, L_T^N, K_T, C_T, L_T^L)'$

The Lagrangean for utility maximum of the fixed-rent tenant is formulated as

$$\begin{aligned} \underset{V^*}{\Omega_T} = &\ U_T(C_T, L_T^L; \psi_T) \\ &+ \lambda_T \begin{pmatrix} pf(D,\ L_T^F, L_T^H, X_T; z_T) - \beta D \\ - p_{XT} X_T - w_T^H L_T^H + \sigma_T w_T^N L_T^N + \overline{Y_T} + K_T - p_{CT} C_T \end{pmatrix} \\ &+ \mu_T (K_T + \sigma_T w_T^N L_T^N - p_{XT} X_T - w_T^H L_T^H - \beta D) \\ &+ \Phi_T (L_T - L_T^F - L_T^N - L_T^L - s_T^{TC} L_T^H) \end{aligned} \tag{4.5}$$

where λ_T, μ_T and Φ_T are Lagrangean multipliers for budget, liquidity and time.

The Kuhn Tucker conditions for utility maximisation yield the optimal solution:

$$\partial\Omega_T/\partial D = \lambda_T(p\,\partial f/\partial D - \beta) - \mu_T \beta \leq 0 \qquad D \geq 0 \qquad D\,\partial\Omega_T/\partial D = 0 \tag{4.6}$$

$$\partial\Omega_T/\partial X_T = \lambda_T p\,\partial f/\partial X_T - (\mu_T + \lambda_T) p_X \leq 0 \qquad X_T \geq 0 \qquad X_T\,\partial\Omega_T/\partial X_T = 0 \tag{4.7}$$

$$\begin{aligned} \partial\Omega_T/\partial L_T^H &= \lambda_T(p\,\partial f/\partial L_T^H - w_T^H) \\ &\quad - \mu_T w_T^H - \Phi_T(s_T^{TC}) \leq 0 \end{aligned} \qquad L_T^H \geq 0 \qquad L_T^H\,\partial\Omega_T/\partial L_T^H = 0 \tag{4.8}$$

$$\partial\Omega_T/\partial L_T^F = \lambda_T p\,\partial f/\partial L_T^F - \Phi_T \leq 0 \qquad L_T^F \geq 0 \qquad L_T^F\,\partial\Omega_T/\partial L_T^F = 0 \tag{4.9}$$

$$\partial\Omega_T/\partial L_T^N = (\lambda_T + \mu_T)\sigma_T w_T^N - \Phi_T \le 0 \qquad L_T^N \ge 0 \qquad L_T^N\,\partial\Omega_T/\partial L_T^N = 0 \qquad (4.10)$$

$$\partial\Omega_T/\partial K_T = \lambda_T + \mu_T \le 0 \qquad K_T \ge 0 \qquad K_T\,\partial\Omega_T/\partial K_T = 0 \qquad (4.11)$$

$$\partial\Omega_T/\partial C_T = \partial U_T/\partial C_T - \lambda_T p_{CT} \le 0 \qquad C_T \ge 0 \qquad C_T\,\partial\Omega_T/\partial C_T = 0 \qquad (4.12)$$

$$\partial\Omega_T/\partial L_T^L = \partial U_T/\partial L_T^L - \Phi_T \le 0 \qquad L_T^L \ge 0 \qquad L_T^L\,\partial\Omega_T/\partial L_T^L = 0 \qquad (4.13)$$

$$\begin{aligned}\partial\Omega_T/\partial\lambda_T &= pf(D, L_T^F, L_T^H, X_T; z_T) - \beta D \\ &\quad - p_{XT}X_T - w_T^H L_T^H + \sigma_T w_T^N L_T^N + \overline{Y_T} \\ &\quad + K_T - p_{CT}C_T \ge 0\end{aligned} \qquad \lambda_T \ge 0 \qquad \lambda_T\,\partial\Omega_T/\partial\lambda_T = 0 \qquad (4.14)$$

$$\begin{aligned}\partial\Omega_T/\partial\mu_T &= K_T + \sigma_T w_T^N L_T^N - p_{XT}X_T \\ &\quad - w_T^H L_T^H - \beta D \ge 0\end{aligned} \qquad \mu_T \ge 0 \qquad \mu_T\,\partial\Omega_T/\partial\mu_T = 0 \qquad (4.15)$$

$$\partial\Omega_T/\partial\Phi_T = L_T - L_T^F - L_T^N - L_T^L - s_T^{TC}L_T^H \ge 0 \qquad \Phi_T \ge 0 \qquad \Phi_T\,\partial\Omega_T/\partial\Phi_T = 0 \qquad (4.16)$$

where λ_T, μ_T and Φ_T represent marginal utilities of income, liquidity and time.

Unlike fixed-rent tenants, sharecroppers have the advantage of deferring the rental payment to the end of the harvest. The tenant receives a fraction α of his output and pays the remaining $(1-\alpha)$ to the landowner. With the exception of Bell and Zusman (1976) and Eswaran and Kotwal (1985), tenancy models have assumed the fraction to be shared as exogenous (Otsuka and Hayami, 1993). With a relatively small number of tenants, Otsuka *et al*. (1992) argued that the share parameter needs not be exogenously given and a bargaining problem will arise. Where many landless tenants exist, the share parameter is fixed exogenously so that the landowner could maximise his utility given the reaction function of the tenant who receives no less than his reservation utility. For food and cash crop production, the tenant's share of output is fixed exogenously at $\alpha = 2/3$.[5]

In sharecropping contracts, the tenant sharecropper will maximise his utility subject to time, budget, liquidity, and non-negativity constraints. The optimisation problem is stated as:

$$\underset{V^*}{Max}\ U_T = U_T(C_T, L_T^L; \psi_T)$$

subject to

$$L_T = L_T^F + L_T^N + L_T^L + s_T^{TC}L_T^H$$

$$\alpha pf(D, L_T^F, L_T^H, X_T; z_T) - p_{XT}X_T - w_T^H L_T^H + \sigma_T w_T^N L_T^N + \overline{Y_T} + K_T - p_{CT}C_T \ge 0 \qquad (4.17)$$

[5] The share parameter is fixed exogenously at $\alpha = 1/2$ for tree crop production in Brong Ahafo. Braverman and Stiglitz (1982) argue that the "equal share" rule breaks down when one introduces uncertainty and information asymmetry into the contract.

$$P_{XT}X_T + w_T^H L_T^H - \sigma_T w_T^N L_T^N < K_T$$
$$D, X_T, K_T, L_T^F, L_T^H, L_T^N, L_T^L, \sigma_T \geq 0$$

where $V' = (D, X_T, L_T^F, L_T^H, L_T^N, K_T, C_T, L_T^L)'$ is vector of decision variables.

Formulating the Lagrangean and using the Kuhn Tucker conditions for utility maximisation yields the relevant first order conditions (see Annex 4.1 for detailed optimisation problem of tenant sharecropper).

4.5.1. Demand for Rented Land

Equation (4.6) is the optimal condition that must be met for tenants to rent-in land under fixed-rent contracts. Equation (4.7) shows the optimal allocation of variable purchased inputs on fixed-rent plots. Equation (4.8) represents the optimal condition for hired farm labour. Equation (4.9) indicates the optimality conditions for family (or own) labour use on the farm. The optimality condition for the farm household's time allocation to off-farm work is shown in (4.10).

In fixed-rent contracts, the amount of land tenants rent-in is determined by the point at which the marginal return from any acre of land $\left(\lambda_T/(\mu_T + \lambda_T)\right) p\,\partial f/\partial D$ is equal to the rent (β). However, the value of marginal product $(\lambda_T \alpha p\,\partial f/\partial D)$ of the cropshare tenant is zero (Annex 4.1). Sharecropping contracts therefore induce tenants to rent-in land until the marginal products are down to zero. At this point, marginal return to labour is at its maximum and that if labour is paid the value of its marginal product, the total product will be exhausted by payment of labour. Landowners will then only be willing to enter into sharecropping contracts with tenants if some returns are expected, and with marginal value products of zero, this is unlikely.[6]

4.5.2. Supply of Rented Land

The owner-cultivator in the fixed-rent contract is paid a rent β (¢/acre/year) in addition to the marginal returns from his own cultivated plot. His total return by entering into a fixed-rent contract is $Y_L^F = pg(\overline{D} - D, L_L^F, L_L^H, X_L; z_L) + \beta D$. At the optimum, the owner-cultivator will employ his resources in the production of crops

[6] Newbery (1974) has pointed out that the zero marginal productivity may be implausible in land-scarce economies. This is because the total amount of land that bears a price may be limited in supply relative to existing demand and all such land, presumably is capable of producing marginal product greater than zero in some uses. He was of the view that most production functions such as the Cobb-Douglas never display zero marginal productivity for land and that equilibrium will simply not exist.

until the value of marginal product of land $\left(\lambda_L/(\lambda_L+\mu_L)\right) p\,\partial g/\partial D$ is equal to the marginal cost. This marginal cost of land must be equal to its price, which is the rent (β) received from the fixed-rent tenant (see Annex 4.2 for formal treatment of this optimisation problem). The shadow price or opportunity cost of renting-out land to tenants under fixed-rent contracts is given by the expression $\left(\lambda_L/(\lambda_L+\mu_L)\right) p\,\partial g/\partial D\big)$. Obviously, the shadow price of land or the opportunity costs forgone for owner-cultivators to rent-out land does not differ from renting-in land by tenants in fixed-rent contract.

Similarly, the overall farm return to the cropshare owner-cultivator is $(1-\alpha)\, pf(D, L_T^F, L_T^H, X_T; z_T) + pg(\overline{D}-D, L_L^F, L_L^H, X_L; z_L)$. At the optimum, the marginal product of own-cultivation $\left(p\,\partial g/\partial D\right)$ is equal to the marginal product of cropshare tenant $\left((1-\alpha) p\,\partial f/\partial D\right)$. See Annex 4.3 for optimisation problem of cropshare owner-cultivator. Hence, income maximising owner-cultivators will self-cultivate rather than enter into sharecropping contracts if $\left(p\,\partial g/\partial D \geq (1-\alpha) p\,\partial f/\partial D\right)$. They would enter into sharecropping contracts if $\left(p\,\partial g/\partial D \leq (1-\alpha) p\,\partial f/\partial D\right)$.

An equilibrium set of contracts is a set of contracts such that no other contract exists which would allocate higher incomes to both the tenant and the owner. For equilibrium contract[7], the marginal product of fixed-rent tenant must be equal to that of sharecropping contract, equilibrium is achieved when the marginal product of own-cultivation is equal to marginal product to crop-share tenants i.e. $\partial g/\partial D = (1-\alpha)\,\partial f/\partial D$.

4.5.3. Labour Allocation

The expression $\left(\lambda_T/(\lambda_T+\mu_T)\right)\alpha p\,\partial f/\partial L_T^H = w_T^H + \left(\Phi_T/(\lambda_T+\mu_T)\right) s_T^{TC}$ is obtained by rearranging (A5) in Annex 4.1. The marginal return from hired farm labour is equal to the wage and supervision time cost. This equilibrium condition for sharecropping contrasts with the standard competitive model where hired labour is employed up to the point where the marginal product of labour is equal to the wage rate. The marginal product of labour is a multiple (α) of the real wage rate and this condition embodies the Marshallian paradigm of inefficiency in sharecropping. The rental share paid to the owner-cultivator is considered as tax on the tenant sharecropper's effort,

[7] These can be proved by equating the optimal conditions for the demand and supply side of the rental market for land in each contract.

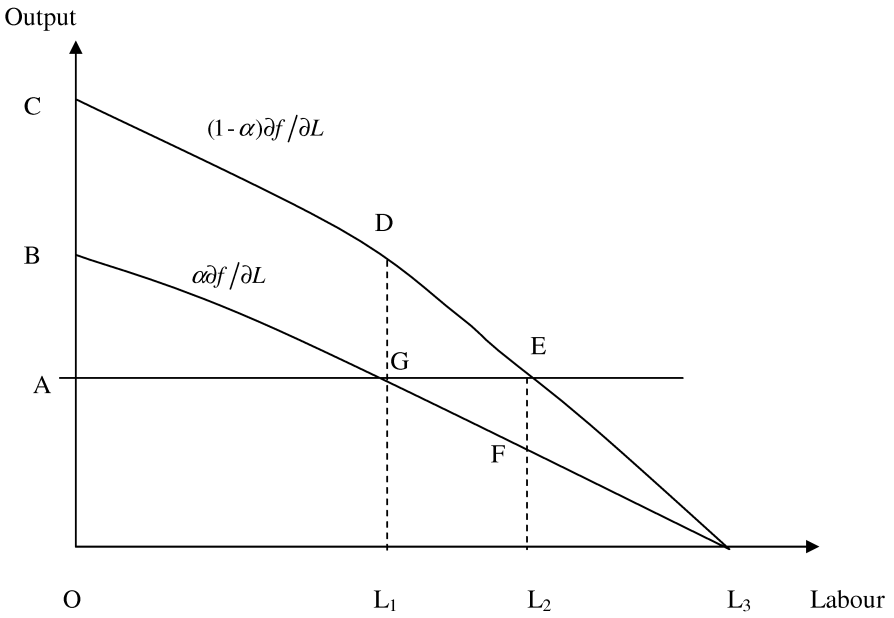
which induces him to reduce his output below the level where the marginal product is equal to the wage rate.

In Figure 4.4, the marginal product of labour to the landowner is $\left((1-\alpha)\partial f/\partial L\right)$ where the rental share he receives from the cropshare tenant is $(1-\alpha)$. The marginal product of labour retained by the cropshare tenant is $\alpha\partial f/\partial L$. The tenant will produce at L_1 where $\alpha\partial f/\partial L = w$ and w is the wage rate. At L_1, the actual marginal benefit DL_1, exceeds the opportunity cost of labour (w). Hsiao (1975) has disputed the application of tax analysis in the Marshallian hypothesis by that both the landowner and the cropshare tenant would strike out a contract that arguing exhausts all gains from the trade. When this happens, L_2 is used instead of L_1 and the total gain of output to the owner is DGFE, while the tenant will be willing to accept any amount greater than his extra labour cost GFE. The maximum the landowner is willing to pay is in excess of the minimum the tenant is willing to accept, so there is room for trade and the point E represents the Pareto-optimal situation where no one could be made better off without making anyone else worse off.

The marginal productivity of family labour $(p\partial f/\partial L_T^F)$ is equal to the shadow price of family time (Φ_T/λ_T) on the farm. Family labour includes the tenant's own time on the farm and/or that of his family members (wife and children). Substituting $\lambda_T = \Phi_T/(p\partial f/\partial L_T^F)$ from equation (4.9) into (4.6) and rearranging yields an expression for the marginal product of land in terms of the marginal product of family labour as $p\partial f/\partial D = \beta\left(1+(\mu_T/\Phi_T)\,p\partial f/\partial L_T^F\right)$. If family labour increases, its marginal product $(\partial f/\partial L_T^F)$ decreases leading to a lower marginal product of land $(\partial f/\partial D)$ but if labour constraint is less binding, then marginal utility of time (Φ) will decrease for the marginal product of land to increase.

The use of family labour and hired labour in sharecropping contracts could also be explained with Figure 4.4. If landowners self-cultivate with hired labour, they will employ their labour up to the point L_2 where $(1-\alpha)\partial f/\partial L = w$. With family labour use in sharecropping contracts, the tenant sharecropper will devote his labour up to the point L_3 where the marginal product $\alpha\partial f/\partial L = 0$, because at this point, the price of family labour is zero. If this duality exists in the labour market then sharecropping is not necessarily inefficient in terms of labour allocation and the Pareto-efficient allocation of labour argument defeats the Marshallian theory. This may partly explain why sharecropping and fixed-rent contracts coexist in most developing countries. Raquibuzzaman (1973) and Mazumdar (1975) used similar arguments but under different framework.

Figure 4.4. Dual Labour Markets Under Sharecropping Contracts.



From (4.10), the number of hours allocated to off-farm employment is positive when $(\lambda_T + \mu_T)\sigma_T w_T^N - \Phi_T = 0$. The fraction of off-farm income σ_T is used in farm activities if $\sigma_T > 0$. Off-farm income will be used if it is available at the peak of farming operations, otherwise $\sigma_T = 0$. At the optimum, off-farm employment participation by the farm household is influenced by the marginal utility of time (Φ), liquidity (μ) and budget (λ) or cash constraints. Rearranging (4.10) and substituting for Φ_T in (4.8) gives $w_T^{H*} = \left(\lambda_T/(\lambda_T + \mu_T)\right) p\partial f/\partial L_T^H - \sigma_T w_T^N s_T^{TC}$, which is the virtual benefit of hired labour or the farm household's willingness to hire farm labour.

If the farm households face binding liquidity constraints, then the marginal product of labour will be high when supervision time cost on hired farm labour increases. An increase in off-farm work participation by the household reduces the liquidity constraints and supervision time cost leading to a decrease in the marginal product of labour and increase in the use of hired farm labour. If the household reduces off-farm work, the liquidity constraint and supervision time cost increase resulting in higher marginal productivity of labour which will induce the farm household to employ less hired labour because of a reduction in the virtual benefit of hired labour. For households that wish to participate in off-farm work and employ

hired farm labour simultaneously, the market wage rate from off-farm work should be greater than the virtual benefit from hired labour. i.e.

$$\left(1/(\lambda_T+\mu_T)\right)\Phi_T/\sigma_T \geq \left(\lambda_T/(\lambda_T+\mu_T)\right) p\partial f/\partial L_T^H - \sigma_T w_T^N s_T^{TC} \tag{4.18}$$

Assuming an interior solution exists, the simultaneous equations involving the first order conditions of the utility maximisation problem of the farm households with fixed-rent and sharecropping plots can be solved in a reduced form. The demand for rented land is a function of some endogenous and exogenous variables expressed as:

$$D_j = D\ (K, Y^N, w^H, p, p_X, \overline{Y}; \psi) \tag{4.19}$$

where j denotes the type of tenancy contract. $j = f$ if land is cultivated under fixed-rent contract and $j = s$ if land is cultivated under sharecropping contract. ψ is a vector of household characteristics denoted by $\psi = \psi(A, E, T)$ where A and E are age, and education of the farmer; T is the duration of stay at the migrant destination.

4.5.4. Impact of Parameter Changes

From the reduced form equation (4.19), the area cultivated under tenancy contracts may be influenced by the household's managerial ability, assets and income sources, transaction costs, relative prices of outputs and inputs, and wages. The expected signs of the parameters of variables explaining area cultivated under fixed-rent or sharecropping contracts are summarised in Table 4.4. To derive the results for the case of a binding budget constraint is to express the budget constraint in (4.4) as a strict equality in order to express D in terms of other parameters and then substituted in the utility maximization problem. The derivation of the comparative statics for D is simply differentiating the first order conditions with respect to D and the parameter of interest, taking advantage of the fact that the second order condition or the second derivative of the maximised utility function with respect to D is negative.

The managerial abilities of the farm household include human capital endowments like age, education, and children of the farmer. Liquid assets from livestock and poultry, and income sources from off-farm income and non-labour income may reduce cash constraints thus enabling the farm households to increase acreage under tenancy. Duration of stay reduces transaction costs and also allows the households to accumulate enough liquid capital necessary to enter into tenancy contracts. Profitability of agriculture due to reduction in wages to hired farm labour and inputs or higher relative prices of outputs may increase the area under tenancy contracts.

Table 4.4. Changes in Parameters of the Explanatory Variables

Explanatory Variables	Dependent Variables: Area cultivated under fixed-rent contract (D_f)	Dependent Variables: Area cultivated under sharecropping contract (D_S)
Liquid wealth *(K)*	+	–
Off-farm income *(Y^N)*	+	–
Non-labour income ($\overline{Y}$)	+	+
Wage rate to hired farm labour *(w^H)*	–	–
Output prices *(P)*	+	+
Input prices (p_X)	–	–
Age of farmer *(A)*	+	+
Education of farmer *(E)*	+/–	+/–
Duration of stay *(T)*	+	–

Note: In a partial equilibrium framework, the sign of a parameter is derived by assuming that other parameters remain constant.

4.6. Empirical Considerations

Empirical models for areas cultivated under sharecropping and fixed-rent contracts are formulated and estimated. Two important aspects of the models must be noted. First, the dependent variable is censored. The area cultivated under fixed-rent or sharecropping contract displayed a number of zeros. Outcome was observed only if the area was cultivated under sharecropping or fixed-rent contract. Second, off-farm income and liquid wealth are two potentially endogenous variables on the right-hand side of the regression model, which need to be corrected for simultaneity bias.

4.6.1. Specification of Empirical Model

Amemiya (1973, 1984) and Maddala (1983) have suggested the Tobit model as the appropriate approach to modelling censored dependent variable. The empirical model is formulated as:

$$D_{ji}^{*} = \omega_1 Y_{ji}^{N} + \omega_2 K_{ji} + \omega_3 \overline{Y}_{ji} + \omega_{4k} P_{ji} + \omega_{5m} \psi_{ji} + \nu_{ji} \qquad (4.20)$$

$D_{Si} = D_{Si}^{*}$ if $D_{Si}^{*} > 0$ and $D_{Si} = 0$ if $D_{Si}^{*} \leq 0$ sharecropping

$D_{fi} = D_{fi}^{*}$ if $D_{fi}^{*} > 0$ and $D_{fi} = 0$ if $D_{fi}^{*} \leq 0$ fixed-rent

where *i* represents household with type of tenancy contract *j*. *D* is the area cultivated, *K* and Y^N denote liquid wealth and off-farm income. $\overline{Y}$ is non-labour income. *P* denotes vector of prices of inputs, outputs, and labour (wage rate). ψ is the vector of household-level characteristics. $\omega_1, \omega_2, \omega_3, \omega_{4k}$ and ω_{5m} are parameters to estimate and ν_{ji} is the error term containing among other things, omitted and unobserved characteristics that affect the farm household.

In this context, off-farm income $(Y^N)^*$ and liquid wealth $(K)^*$ are latent variables. Following Amemiya (1979) and Keshk (2003), the endogenous variables can be expressed in reduced form equations as:

$$(Y_{ji}^N)^* = \delta_1 G_{ji} + \eta_{ji} \tag{4.21}$$
$$Y_{ji}^N = (Y_{ji}^N)^* \text{ if } (Y_{ji}^N)^* > 0 \text{ and } Y_{ji}^N = 0 \text{ if } (Y_{ji}^N)^* \leq 0$$

$$K_{ji}^* = \rho_1 R_{ji} + \gamma_{ji} \tag{4.22}$$
$$K_{ji} = K_{ji}^* \text{ if } K_{ji}^* > 0 \text{ and } K_{ji} = 0 \text{ if } K_{ji}^* \leq 0$$

where *G* and *R* are vectors of variables (or instruments) for off-income and liquid wealth, $\delta's$ and $\rho's$ are parameters to estimate, and η, γ are error terms.

The two-step instrumental variables (IV) technique suggested by Nelson and Olson (1978) and Newey (1987) is employed in the estimation of the models. In the first step, (4.21) and (4.22) are estimated with Tobit maximum likelihood since off-farm income and liquid wealth were not continuously observed among the sampled farm households. The second step involves the substitution of predicted values of off-farm income and liquid wealth in (4.20) to obtain the final model to be estimated with Tobit maximum likelihood. The vector of household characteristics (ψ) contains instrumental variables that are unrelated to the area cultivated but highly related to off-farm income and liquid wealth (Staiger and Stock, 1997). The instruments for liquid wealth were age, education, veterinary visits and religion. Off-farm income was instrumented by age, education, religion and household demographic characteristics such as adult children (>15 years) and non-adult children (<15 years). The household characteristics control for skills and managerial ability.

Location dummies capture unobserved locational characteristics such as segmented land markets, transaction, and search costs that have the tendency to put pressure on land rents and influence rent prices at the village-level. To correct for potential measurement error in the estimated standard errors (Maddala, 1983; Murphy and Topel, 1985, the analysis of bootstrapping is used. While some research has expressed reservation on the Tobit model because of the strict assumption of normality, Heckman (1979) argues that specification of the regression function and

the set of instrumental variables are more important in the IV Tobit model than specification of the error distribution.

4.6.2. Empirical Results

Table 4.5 presents the standard Tobit and IV Tobit results on area cultivated under fixed-rent contract. The mean fixed-rent acreage is 3.11 and standard deviation is 3.93 (Annex 4.4 reports descriptive statistics). To test for endogeneity of off-farm income and liquid wealth in the equation, the Smith-Blundell (1986) test of exogeneity was used. This test is an alternative to the commonly used Hausman test (Hausman, 1978; 1983). It was conducted under the assumptions that the IV estimates were consistent and that under the null hypothesis, predicted off-farm income and liquid wealth have no explanatory power (Heckman, 1978). The *F*-value and *p*-value from the Smith-Blundell exogeneity test are 1.19 and 0.3059, respectively. The null hypothesis that off-farm income and liquid wealth were exogenous in the fixed-rent equation cannot be rejected. Off-farm income has a significant positive influence on the area under fixed-rent contract. This empirical result agrees with an assertion by Otsuka and Hayami (1988) that an increase in off-farm employment opportunities is expected to increase the area under fixed-rent as it tends to reduce cash constraints of tenants. The empirical results also indicate a positive significant relationship between liquid wealth and acreage under fixed-rent contract in both the standard and IV Tobit models.

The combined effect of age of the farmer on fixed-rent acreage is positive although it is not significant even at 10 percent. However, years of formal education is significant and had the correct hypothesised sign. The age and education variables proxy for managerial ability and skills of the farmer. Other things being equal, more experienced migrants are expected to increase the area under fixed-rent contracts. Wages to hired farm labour were significant and positively related to fixed- rent acreages, a result which indicates that higher wages did not discourage tenants from renting fixed-rent plots. The output price of maize has a positive relationship with fixed-rent acreages as hypothesised. However, the price of fertiliser has the correct negative sign but it was insignificant. With the exception of Woraso none of the location dummies had a significant relationship with fixed-rent acreage. The default locations dropped due to multicollinearity were Nkwaeso and Ayerede.

Table 4.5. Estimation Results for Area Cultivated Under Fixed-Rent Contract

	Standard Tobit		IV Tobit	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Constant	-21.4555	-0.42	-7.5689	-0.15
Off-farm income†	0.0957	1.21	0.2870	1.67*
Liquid wealth†	0.0325	2.80***	0.0669	2.04**
Age	0.1899	1.07	0.1893	0.97
$(\text{Age})^2$	-0.0017	-0.96	-0.0015	-0.81
Years of formal education	0.1333	1.40	0.1675	1.69*
Duration of stay	0.1762	1.70*	0.1616	1.53
$(\text{Duration of stay})^2$	-0.0025	-1.19	-0.0023	-1.04
Non-labour income	-0.6164	-0.99	-0.5574	-0.87
Wage rate to hired labour	2.3256	3.06***	2.6387	3.20***
Prices of maize	34.4112	1.61	35.8551	1.65*
Prices of fertiliser	-42.9356	-0.34	-92.8879	-0.73
Twimea-Nkwanta	0.8056	0.36	1.4166	0.60
Aworopata	3.4173	0.83	5.0872	1.14
Woraso	-8.4629	-4.41***	-9.8385	-4.40***
Dromankese	-0.1425	-0.09	-0.3097	-0.19
Number of Observations		183		183
Log-Likelihood		-370.22		-371.99
Pseudo R^2		0.1006		0.0963
Smith-Blundell: F (2,180)				1.19

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.
† Refers to variables instrumented in the model
Source: Author's Compilation from NWO Survey (2003).

The empirical results on the area cultivated under sharecropping contract are presented in Table 4.6. Using the Smith-Blundell exogeneity test, the null hypothesis that off-farm income and liquid wealth were exogenous in the sharecropping equation was not rejected for F-value of 1.73 and p-value of 0.1806. Unlike the area under fixed-rent contract, liquid wealth is negative and had no significant impact on acreage under sharecropping contracts. Similar to fixed-rent contracts off-farm income is significant and positively related to acreage under sharecropping contract. The empirical results lend support to the theoretical belief that migrant tenants with higher earnings from off-farm employments increase acreage under fixed-rent or share-cropping contracts. However, this is not true for tenants under sharecropping contracts. The schooling variable had the correct hypothesised sign but again was not statistically significant even at 10 percent.

Table 4.6. Estimation Results for Area Cultivated Under Sharecropping Contract

	Standard Tobit		IV Tobit	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Constant	6.2993	0.09	13.8497	0.21
Off-farm income†	0.0107	0.12	0.4423	2.30**
Liquid wealth†	-0.0267	-1.10	-0.0424	-1.14
Age	-0.0487	-0.26	0.1130	0.55
(Age)^2	0.0005	0.25	-0.0007	-0.35
Years of formal education	0.0687	0.62	0.0697	0.63
Duration of stay	0.0685	0.57	0.0410	0.35
(Duration of stay)^2	-0.00004	-0.02	0.0002	0.10
Non-labour income	-0.3116	-0.30	-0.5409	-0.54
Wage rate to hired labour	-3.6069	-3.86***	-4.0808	-4.15***
Prices of maize	-27.2051	-1.04	-32.4261	-1.28
Prices of fertiliser	112.8265	0.67	98.1858	0.60
Twimea-Nkwanta	-5.9939	-2.42**	-8.0251	-3.11***
Aworopata	-15.3437	-3.26***	-17.7011	-3.55***
Woraso	8.1791	3.30***	10.4842	3.78***
Dromankese	-4.0508	-2.08**	-4.2865	-2.23**
Number of Observations	183		183	
Log-Likelihood	-277.39		-274.64	
Pseudo R^2	0.0484		0.0578	
Smith-Blundell: F (2,180)			1.73	

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.
† Refers to variables instrumented in the model
Source: Author's Compilation from NWO Survey (2003).

Duration of stay is expected to allow migrant tenants to accumulate enough liquid wealth to overcome cash constraints. It had the positive relationship with share-cropping acreages as expected but was insignificant even at 10 percent. Wage rate to hired farm labour was significant at 1 percent and negatively related to the area cultivated under sharecropping contracts, a result which is consistent with the preposition that cropshare acreages decrease when hired farm labour wages rise. With the exception of the positive location dummy for Woraso, all the other location dummies are negative and significant. Hence village-level effects such as location of the migrant and local rental or labour market imperfections probably limit the expansion of sharecropping acreages.

4.6.3. Simulation of Area Cultivated under Tenancy

The importance of off-farm income, liquid wealth and wages to hired farm labour in acreage decisions of the farm households could be captured by simulated results in Table 4.7 which explains how much land area would be cultivated if we move from

the 10th to 90th percentile of the distribution for each of the determinants. The area under fixed-rent contract would increase by 1.27 units if the distribution for off-farm earnings of the households moves from the 10th to 90th percentile but cropshare acreages would increase by 1.30 units. These simulated results confirm the empirical results that migrant tenants with earnings from off-farm employments tend to increase more area under sharecropping and fixed-rent contracts.

Table 4.7. Simulation Results of Area Cultivated Under Tenancy Contracts

	Area Cultivated (acres)			
Simulations	10th Percentile	Median	90th Percentile	Absolute Change
Fixed-rent contract				
Off-farm income	2.59	3.15	3.86	1.27
Liquid wealth	2.46	3.10	4.09	1.63
Wage rate to hired labour	0.10	2.91	9.44	9.35
Sharecropping contract				
Off-farm income	0.91	1.42	2.21	1.30
Liquid wealth	1.79	1.48	1.13	-0.66
Wage rate to hired labour	15.97	3.19	0.18	-15.78

Note: The absolute change in the rows for off-farm income, liquid wealth and wage rate to hired labour represents how much fixed-rent or sharecropping acreage would change in response to a change in those variables from the 10th to 90th percentile of the distribution.
Source: Author's Compilation from NWO Survey (2003).

If the liquid wealth of the migrant tenant increases from the 10th to 90th percentile of the distribution, there is an increase in fixed-rent acreages by 1.65 units but a decrease of 0.66 units in cropshare acreages. This simulated result lends credence to the hypothesis that tenants with less liquidity would increase the area under sharecropping but decrease the area under fixed-rent contract. Fixed-rent acreages increase by 9.35 units but the area cultivated under sharecropping contract decreases by 15.78 units when the distribution for wages to hired farm labour increases from the 10th percentile to the 90th percentile.

4.7. Summary and Conclusions

It has been noted in this Chapter that the land rental market was very active in the Brong Ahafo Region so the different tenure arrangements serve as economic incentives to the migrant farm households and allow them to generate the necessary income on-farm. This is an important finding which is going to be the subject of investigation in the subsequent Chapters. The study found coexistence of wage contract (owner-cultivation) and rent-contracts (fixed-rent and sharecropping) among

Upper East migrant farm households in the Brong Ahafo Region of Ghana. This finding is quite unique from other tenancy arrangements studied in most parts of Southeast Asia where sole-renting regimes appear to be prevalent. Observations on tenant's plots revealed relative differences in labour inputs and yields which may be attributed to farm household characteristics such as initial endowments, tenure status and farm characteristics that affect the farm household's utility. Input use and yields were higher on fixed-rent plots and owner-cultivated plots than cropshare plots but this must be viewed from the Marshallian disincentive perspective.

In contrast with other empirical studies, no significant relationships were found between length of stay at the migrant place of destination and acreages under fixed-rent contract or sharecropping contract. A similar finding was also observed for the managerial ability of the farmer in this study. Due to the absence of perfect markets, migrant farm households are often faced with liquidity and institutionally imposed constraints such as lack of credit and insurance in accessing land. The empirical investigations reveal the importance of liquidity constraints on acreage decisions of migrant tenants. In particular, people with more wealth rent more land under fixed rent contracts but there is no clear pattern for sharecropping contracts. It cannot be concluded that sharecropping is an inferior choice and that no farmer would ever rent if he had the liquidity needed for a fixed rent contract because with the Ghanaian data we do observe households who operate land simultaneously under both rental regimes. The simulated results also confirm some of the empirical results. In particular, increasing the tenant's off-farm income from the 10^{th} to 90^{th} percentile of the distribution leads to an increase of 1.27 units in fixed-rent acreages and a decrease of 1.30 units in cropshare acreages. The results were also consistent with the hypothesis that tenants tend to increase sharecropped acreages when wages to hired farm labour decrease, however, this may not be plausible for the area under fixed-rent contracts.

Annex 4.1. Optmisation Problem of Tenant Sharecropper

The tenant sharecropper will maximise his utility subject to time, budget, and liquidity and non-negativity constraints. The optimisation problem is stated as:

$$\underset{V^*}{Max}\ U_T = U_T(C_T, L_T^L; \psi_T)$$

subject to

$$\text{Time constraint, } L_T = L_T^F + L_T^N + L_T^L + s_T^{TC} L_T^H$$

$$\text{Budget constraint, } \begin{matrix} \alpha pf(D, L_T^F, L_T^H, X_T; z_T) - p_{XT} X_T - w_T^H L_T^H \\ +\sigma_T w_T^N L_T^N + \overline{Y_T} + K_T - p_{CT} C_T \geq 0 \end{matrix} \quad \text{(A1)}$$

$$\text{Liquidity constraint, } P_{XT} X_T + w_T^H L_T^H - \sigma_T w_T^N L_T^N < K_T$$

$$\text{Non-negativity constraint, } D, X_T, K_T, L_T^F, L_T^H, L_T^N, L_T^L, \sigma_T \geq 0$$

where $V' = (D, X_T, L_T^F, L_T^H, L_T^N, K_T, C_T, L_T^L)'$ is vector of decision variables.

The Lagrangean for utility maximum is written as:

$$\begin{aligned} \underset{V^*}{\Omega} &= U_T(C_T, L_T^L; \psi_T) \\ &+ \lambda_T \begin{pmatrix} \alpha p f(D, L_T^F, L_T^H, X_T; z_T) - p_{XT} X_T \\ -w_T^H L_T^H + \sigma_T w_T^N L_T^N + \overline{Y_T} + K_T - p_{CT} C_T \end{pmatrix} \\ &+ \mu_T (K_T + \sigma_T w_T^N L_T^N - p_{XT} X_T - w_T^H L_T^H) \\ &+ \Phi_T (L_T - L_T^F - L_T^N - L_T^L - s_T^{TC} L_T^H) \end{aligned} \quad \text{(A2)}$$

where λ_T, μ_T and Φ_T have their usual meanings.

The optimal solutions from the Kuhn Tucker conditions for utility maximisation:

$$\partial\Omega_T/\partial D = \lambda_T \alpha p\, \partial f/\partial D \leq 0 \qquad D \geq 0 \qquad D\, \partial\Omega_T/\partial D = 0 \quad \text{(A3)}$$

$$\partial\Omega_T/\partial X_T = \lambda_T \alpha p\, \partial f/\partial X_T - (\mu_T + \lambda_T) p_X \leq 0 \qquad X_T \geq 0 \qquad X_T\, \partial\Omega_T/\partial X_T = 0 \quad \text{(A4)}$$

$$\begin{matrix} \partial\Omega_T/\partial L_T^H = \lambda_T(\alpha p\, \partial f/\partial L_T^H - w_T^H) \\ \quad - \mu_T w_T^H - \Phi_T(s_T^{TC}) \leq 0 \end{matrix} \qquad L_T^H \geq 0 \qquad L_T^H\, \partial\Omega_T/\partial L_T^H = 0 \quad \text{(A5)}$$

$$\partial\Omega_T/\partial L_T^F = \lambda_T \alpha p\, \partial f/\partial L_T^F - \Phi_T \leq 0 \qquad L_T^F \geq 0 \qquad L_T^F\, \partial\Omega_T/\partial L_T^F = 0 \quad \text{(A6)}$$

$$\partial\Omega_T/\partial L_T^N = (\lambda_T + \mu_T)\sigma_T w_T^N - \Phi_T \leq 0 \qquad L_T^N \geq 0 \qquad L_T^N\, \partial\Omega_T/\partial L_T^N = 0 \quad \text{(A7)}$$

$$\partial\Omega/\partial K_T = \lambda_T + \mu_T \leq 0 \qquad K_T \geq 0 \qquad K_T\, \partial\Omega_T/\partial K_T = 0 \quad \text{(A8)}$$

$$\partial\Omega_T/\partial C_T = \partial U_T/\partial C_T - \lambda_T p_{CT} \leq 0 \qquad C_T \geq 0 \qquad C_T\, \partial\Omega_T/\partial C_T = 0 \quad \text{(A9)}$$

$$\partial\Omega_T/\partial L_T^L = \partial U_T/\partial L_T^L - \Phi_T \leq 0 \qquad L_T^L \geq 0 \qquad L_T^L\, \partial\Omega_T/\partial L_T^L = 0 \quad \text{(A10)}$$

$$\partial\Omega_T/\partial\lambda_T = \alpha\, pf(D, L_T^F, L_T^H, X_T; z_T) - p_{XT}X_T - w_T^H L_T^H + \sigma_T w_T^N L_T^N + \overline{Y_T} + K_T - p_{CT}C_T \geq 0 \qquad \lambda_T \geq 0 \qquad \lambda_T\, \partial\Omega_T/\partial\lambda_T = 0 \qquad \text{(A11)}$$

$$\partial\Omega_T/\partial\mu_T = K_T + \sigma_T w_T^N L_T^N - p_{XT}X_T - w_T^H L_T^H \geq 0 \qquad \mu_T \geq 0 \qquad \mu_T\, \partial\Omega_T/\partial\mu_T = 0 \qquad \text{(A12)}$$

$$\partial\Omega_T/\partial\Phi_T = L_T - L_T^F - L_T^N - L_T^L - s_T^{TC} L_T^H \geq 0 \qquad \Phi_T \geq 0 \qquad \Phi_T\, \partial\Omega_T/\partial\Phi_T = 0 \qquad \text{(A13)}$$

Annex 4.2. Optimisation Problem of Owner-cultivated Household in Fixed-Rent Contract

The farm returns of owner cultivated household in fixed-rent contract is

$$Y_L^F = pF(\overline{D} - D, L_L^F, L_L^H, X_L, H_L) + \beta D \tag{A14}$$

The optimisation problem is stated as:

$$\begin{gathered}
\underset{\Theta^*}{Max}\ U_L = U_L(C_L, L_L^L, z_L) \\
\text{subject to} \\
\text{Time constraint, } L_L = L_L^F + L_L^N + L_L^L + s_L^{TC} L_L^H \\
\text{Budget constraint, } \begin{matrix} pF(\overline{D} - D, L_L^F, L_L^H, X_L, H_L) + \beta D - p_{XL} X_L \\ -w_L^H L_L^H + w_L^N L_L^N + \overline{Y_L} + K_L - p_{CL} C_L \geq 0 \end{matrix} \\
\text{Liquidity constraint, } P_{XL} X_L + w_L^H L_L^H - \beta D < K_L \\
\text{Non-negativity constraint, } D, X_L, L_L^H, L_L^F, L_L^N, L_L^L \geq 0 \text{ and } \overline{D} - D \geq 0 \\
\text{where } \Theta' = \Theta(D, X_L, L_L^F, L_L^H, L_L^N, L_L^L, C_L)' \text{ is vector of decision variables.}
\end{gathered} \tag{A15}$$

The Lagrangean for owner-cultivated households in fixed-rent contracts is:

$$\begin{aligned}
\underset{\Theta^*}{\Omega} &= U_L(C_L, L_L^L, z_L) \\
&+ \lambda_L \begin{pmatrix} pF(\overline{D} - D, L_L^F, L_L^H, X_L, H_L) + \beta D - p_{XL} X_L \\ -w_L^H L_L^H + w_L^N L_L^N + \overline{Y_L} + K_L - p_{CL} C_L \end{pmatrix} \\
&+ \mu_L (K_L - p_{XL} X_L - w_L^H L_L^H + \beta D) \\
&+ \Phi_L (L_L - L_L^F - L_L^N - L_L^L - s_L^{TC} L_L^H)
\end{aligned} \tag{A16}$$

where λ_L, μ_L and Φ_L are Lagrangean multipliers for household income, liquidity, and time respectively.

The optimal solutions are:

$$\partial\Omega_L/\partial D = \lambda_L(-p\,\partial F/\partial D) + \lambda_L(\beta) + \mu_L\beta \leq 0 \quad D \geq 0 \quad D\,\partial\Omega_L/\partial D = 0 \tag{A17}$$

$$\partial\Omega_L/\partial X_L = \lambda_L p\,\partial F/\partial X_L - (\mu_L + \lambda_L) p_{XL} \leq 0 \quad X_L \geq 0 \quad X_L\,\partial\Omega_L/\partial X_L = 0 \tag{A18}$$

$$\begin{aligned}
\partial\Omega_L/\partial L_L^H &= \lambda_L(p\partial F/\partial L_L^H - w_L^H) - \Phi_L(s_L^{TC}) \\
&\quad - \mu_L(w_L^H) \leq 0
\end{aligned} \quad L_L^H \geq 0 \quad L_L^H\,\partial\Omega_L/\partial L_L^H = 0 \tag{A19}$$

$$\partial\Omega_L/\partial L_L^F = \lambda_L p\,\partial F/\partial L_L^F - \Phi_L \leq 0 \quad L_L^F \geq 0 \quad L_L^F\,\partial\Omega_L/\partial L_L^F = 0 \tag{A20}$$

$$\partial\Omega_L/\partial L_L^N = \lambda_L w_L^N - \Phi_L \leq 0 \quad L_L^N \geq 0 \quad L_L^N\,\partial\Omega_L/\partial L_L^N = 0 \tag{A21}$$

$$\partial\Omega_L/\partial K_L = \lambda_L + \mu_L \leq 0 \quad K_L \geq 0 \quad K_L\,\partial\Omega_L/\partial K_L = 0 \tag{A22}$$

$$\partial\Omega_L/\partial C_L = \partial U_L/\partial C_L - \lambda_L p_{CL} \le 0 \qquad C_L \ge 0 \qquad C_L\,\partial\Omega_L/\partial C_L = 0 \qquad \text{(A23)}$$

$$\partial\Omega_L/\partial L_L^L = \partial U_L/\partial L_L^L - \Phi_L \le 0 \qquad L_L^L \ge 0 \qquad L_L^L\,\partial\Omega_L/\partial L_L^L = 0 \qquad \text{(A24)}$$

$$\begin{aligned}\partial\Omega_L/\partial\lambda_L = {} & pF(\overline{D} - D, L_L^F, L_L^H, X_L, H_L) + \beta D \\ & - p_{XL}X_L - w_L^H L_L^H + w_L^N L_L^N + \overline{Y_L} \\ & + K_L - p_{CL}C_L \ge 0\end{aligned} \qquad \lambda_L \ge 0 \qquad \lambda_L\,\partial\Omega_L/\partial\mu_L = 0 \qquad \text{(A25)}$$

$$\partial\Omega_L/\partial\mu_L = K_L - p_{XL}X_L - w_L^H L_L^H + \beta D \ge 0 \qquad \mu_L \ge 0 \qquad \mu_L\,\partial\Omega_L/\partial\mu_L = 0 \qquad \text{(A26)}$$

$$\partial\Omega_L/\partial\Phi_L = L_L - L_L^F - L_L^N - L_L^L - s_L^{TC}L_L^H \ge 0 \qquad \Phi_L \ge 0 \qquad \Phi_L\,\partial\Omega_L/\partial\Phi_L = 0 \qquad \text{(A27)}$$

Annex 4.3. Optimisation Problem of Owner-cultivated Household in Sharecropping Contract

The overall farm returns of landowner is

$$(1-\alpha)\, pf(D, L_T^F, L_T^H, X_T, H_T) + pF(\overline{D} - D, L_L^F, L_L^H, X_L, H_L) \tag{A28}$$

The optimisation problem of owner-cultivated household is

$$\underset{\Theta^*}{Max}\ U_L = U_L(C_L, L_L^L, z_L)$$

subject to

$$\text{Time constraint, } L_L = L_L^F + L_L^N + L_L^L + s_L^{TC} L_L^H \tag{A29}$$

$$\text{Budget constraint, } \begin{matrix}(1-\alpha)\, pf(D, L_T^F, L_T^H, X_T, H_T) + pF(\overline{D} - D, L_L^F, L_L^H, X_L, H_L) \\ - p_{XL} X_L - w_L^H L_L^H + w_L^N L_L^N + \overline{Y_L} + K_L - p_{CL} C_L \geq 0\end{matrix}$$

$$\text{Liquidity constraint, } P_{XL} X_L + w_L^H L_L^H < K_L$$

$$\text{Non-negativity constraint, } D, X_L, L_L^H, L_L^F, L_L^N, L_L^L \geq 0 \text{ and } \overline{D} - D \geq 0$$

The Lagrangean for owner-cultivated household in sharecropping contract is:

$$\begin{aligned}\underset{\Theta^*}{\Omega_L} &= U_L(C_L, L_L^L, z_L) \\ &+ \lambda_L \begin{pmatrix}(1-\alpha)\, pf(D, L_T^F, L_T^H, X_T, H_T) + pF(\overline{D} - D, L_L^F, L_L^H, X_L, H_L) \\ - p_{XL} X_L - w_L^H L_L^H + w_L^N L_L^N + \overline{Y_L} + K_L - p_{CL} C_L\end{pmatrix} \\ &+ \mu_L (K_L - p_{XL} X_L - w_L^H L_L^H) \\ &+ \Phi_L (L_L - L_L^F - L_L^N - L_L^L - s_L^{TC} L_L^H)\end{aligned} \tag{A30}$$

where λ_L, μ_L, δ_L and Φ_L have their usual meanings

The optimal solutions are:

$$\partial\Omega_L/\partial D = \lambda_L p\left((1-\alpha)\,\partial f/\partial D - \partial F/\partial D\right) \leq 0 \quad D \geq 0 \quad D\,\partial\Omega_L/\partial D = 0 \tag{A31}$$

$$\partial\Omega_L/\partial X_L = \lambda_L p\,\partial F/\partial X_L - (\mu_L + \lambda_L) p_{XL} \leq 0 \quad X_L \geq 0 \quad X_L\,\partial\Omega_L/\partial X_L = 0 \tag{A32}$$

$$\partial\Omega_L/\partial L_L^H = \lambda_L (p\partial F/\partial L_L^H - w_L^H) - \mu_L (w_L^H) - \Phi_L (s_L^{TC}) \leq 0 \quad L_L^H \geq 0 \quad L_L^H\,\partial\Omega_L/\partial L_L^H = 0 \tag{A33}$$

$$\partial\Omega_L/\partial L_L^F = \lambda_L p\,\partial F/\partial L_L^F - \Phi_L \leq 0 \quad L_L^F \geq 0 \quad L_L^F\,\partial\Omega_L/\partial L_L^F = 0 \tag{A34}$$

$$\partial\Omega_L/\partial L_L^N = \lambda_L w_L^N - \Phi_L \leq 0 \quad L_L^N \geq 0 \quad L_L^N\,\partial\Omega_L/\partial L_L^N = 0 \tag{A35}$$

$$\partial\Omega_L/\partial K_L = \lambda_L + \mu_L \leq 0 \quad K_L \geq 0 \quad K_L\,\partial\Omega_L/\partial K_L = 0 \tag{A36}$$

$$\partial\Omega_L/\partial C_L = \partial U_L/\partial C_L - \lambda_L p_{CL} \leq 0 \quad C_L \geq 0 \quad C_L\,\partial\Omega_L/\partial C_L = 0 \tag{A37}$$

$$\partial\Omega_L/\partial L_L^L = \partial U_L/\partial L_L^L - \Phi_L \leq 0 \quad L_L^L \geq 0 \quad L_L^L\,\partial\Omega_L/\partial L_L^L = 0 \tag{A38}$$

$$\partial\Omega_L/\partial\lambda_T = (1-\alpha)\,pf(D, L_T^F, L_T^H, X_T, H_T) + pF(\overline{D}-D, L_L^F, L_L^H, X_L, H_L) - p_{XL}X_L - w_L^H L_L^H + w_L^N L_L^N + \overline{Y_L} + K_L - p_{CL}C_L \geq 0 \qquad \lambda_L \geq 0 \qquad \lambda_L\,\partial\Omega_L/\partial\mu_L = 0 \qquad \text{(A39)}$$

$$\partial\Omega_L/\partial\mu_L = K_L - p_{XL}X_L - w_L^H L_L^H \geq 0 \qquad \mu_L \geq 0 \qquad \mu_L\,\partial\Omega_L/\partial\mu_L = 0 \qquad \text{(A40)}$$

$$\partial\Omega_L/\partial\Phi_L = L_L - L_L^F - L_L^N - L_L^L - s_L^{TC}L_L^H \geq 0 \qquad \Phi_L \geq 0 \qquad \Phi_L\,\partial\Omega_L/\partial\Phi_L = 0 \qquad \text{(A41)}$$

Annex 4.4.

Descriptive Statistics of Area Cultivated under Tenancy Contracts

Variables	Mean	Standard Deviation
Acreage under fixed-rent	3.11	3.93
Acreage under sharecropping	1.47	2.62
Off-farm income	2.72	4.99
Liquid wealth	14.33	30.91
Age (years)	45.83	13.35
Education (years)	2.07	3.96
Duration of stay (years)	13.61	10.29
Adult children (>15 years)	2.37	1.73
Non-adult children (<15 years)	0.86	1.39
Non-labour income (¢)	0.13	2.05
Wage rate to hired farm labour (¢/day)	12.51	2.05
Price of fertiliser (¢/kg)	0.38	0.003
Price of maize (¢/bag)	0.102	0.017
If household is religious	0.67	0.47
If household received veterinary visit	0.38	0.49
If household is located at Twimea-Nkwanta	0.20	0.40
If household is located at Woraso	0.15	0.36
If household is located at Aworopata	0.10	0.31
If household is located at Dromankese	0.11	0.31

Note: Off-farm income and liquid wealth are in millions Ghanaian Cedis (¢) and prices of inputs and outputs are in thousands Ghanaian Cedis (¢). Exchange rate: US$1=¢8500 in 2003.

Source: Author's Compilation from NWO Survey (2003).

Chapter 5

On-Farm Income Generation

Various income opportunities are opened to Upper East migrant farm households when they arrive in Brong Ahafo. To improve their relative income positions they could explore income possibilities on-farm or engage in some form of non-farm employment that bring returns to the households. Notwithstanding the liquidity constraints faced by most of the households, it was noted in the previous Chapter that about 74 percent were able to access fixed-rent and sharecropping plots with the aim of entering into farming so that they could generate income from food crop production. Increasing land endowments to landless farm households has significant impact on their productivity. But on-farm income generation through food crop production requires effective resource allocation and better production systems within the farm households. This Chapter therefore examines how the migrant farm households generated income from food crop production on rented land.

The migrants come from the Upper East, one of the most food-insecure regions in Ghana. Although farmers in the region cultivate various crops, they often do so under severe environmental conditions on plots whose carrying capacities have almost exceeded due to population pressure on land. Most rural dwellers in Brong Ahafo where Upper East migrants settle derive their income from agriculture. Approximately 70 percent of the economic active population in Brong Ahafo is engaged in agricultural production. The forest soils in the region are of good quality and the savannah lands which landowners periodically put to fallow allow farmers to grow a variety of crops. Moreover, the region is noted as one of the grain-exporting regions in Ghana.

This Chapter is structured as follows. Section 1 contains a general description of the household's crop choice and sale of farm produce. The contributions of food crops to the household's income are assessed by calculating the economic returns of the predominant crops first for single crops, and then for some crop combinations. Section 2 explores the labour inputs of the farm households. Employing the instrumental variable (IV) estimation technique, the determinants of the effects of hired farm labour demand is quantified in Section 3. The production technology of the farm households is investigated with a value-added production function specified in a Cobb-Douglas functional form in Section 4. The value-added production function is estimated using the instrumental variable (IV) approach. Section 5 provides some conclusions. Having determined in this Chapter how much income the households generate through food crop production, the next Chapter will evaluate the income generation from off-farm employment.

5.1. Crop Choice

The incentive for the households to generate income from growing a particular crop depends on a number of factors. In Brong Ahafo, farmers generally depend on rain-fed agriculture. Whilst the major cropping season (peak) starts in March and ends in July, the minor season (lean) begins in September and lasts till November making it possible for farmers to grow crops all year round. In addition to the two rainy seasons, the forest and savannah soils in the region support the production of annual and perennial crops. Apart from these favourable environmental conditions, farmers must have adequate capital to support the growth of the crop in terms of input use such as labour and purchased inputs like fertiliser, and improved seeds and so on. Moreover, an attractive feature of growing crops especially for the small farmer is its marketability since some staple crops sell quite well at small farmer markets and other consumer venues.

Three important issues on the production decisions of the farm households will be considered in this Section. First, the types of crops the migrant farm households cultivated on rented plots are compared to those of owner-cultivators. The gross income per acre generated by the households through food crop production during the major and the minor seasons in 2003 are also assessed. Second, the sale of farm produce and factor allocations over the crops they cultivated are discussed. Finally, the economic returns of crops cultivated as single crops and intercrop mixtures are estimated.

5.1.1. Types of Crops Grown

The farm households cultivated various crops but the predominant ones were maize, yam, cassava, beans, groundnuts, onions and tomatoes. Apart from these food crops, some migrant households cultivated tree crops like mango, orange, oil palm etc. Owner-cultivators also planted trees like teak, cashew, and oil palm. Migrant farm households that planted teak and cashew were those who accessed taungya plots in the Techiman District (tree planting will be discussed in detail in Chapter 8 under sustainable farming practices of the migrant farm households).

To ensure economic sustainability, the households must grow crops that support the family farm at an acceptable economic level and which also enhance the environment. The households then cultivated some crops as single crops and intercrop mixtures. The intercrop mixtures as indicated in Table 5.1 included cereal, legume, yam-cassava, plantain and vegetable-based intercrops. The proportions of migrant and owner-cultivated plots that were under single maize cultivation exceeded all other single crops. However, more migrant plots were used for single maize than plots of owner-cultivators. Maize is a potential cash and subsistence crop in Ghana. Apart from the Brong Ahafo Region, the Northern and the Ashanti Regions also contribute significantly to maize production in Ghana.

Table 5.1. Percentage of Rented and Owner-Cultivated Plots under Crops

Crops	Migrants (%)		Owners (%)	
	Techiman	Nkoranza	Techiman	Nkoranza
Single				
Maize	67 (68)	79 (87)	59 (73)	72 (77)
Yam	7 (5)	13 (6)	16 (12)	16 (18)
Cassava	8 (7)		3 (1)	4 (2)
Beans	9 (11)		8 (5)	4 (1)
Groundnuts	2 (3)	6 (6)	3 (4)	4 (2)
Onion	3 (3)	1 (1)		
Tomatoes	4 (3)		11 (5)	
Intercrop-mix				
Cereal- based [a]	54 (50)	74 (59)	58 (41)	50 (46)
Legume-based [b]	16 (14)	21 (33)	14 (14)	19 (24)
Yam-cassava [c]	9 (12)	5 (8)	14 (22)	21(15)
Plantain-based [d]	20 (23)		12 (19)	2 (12)
Vegetable-based [e]	1 (1)		2 (4)	8 (3)

Note: Figures in parentheses are percentage areas under crops.

a. Combination of maize with sorghum, or yam, or cassava or tomatoes.

b. Combination of groundnut or beans with maize, or yam, cassava or tomatoes.

c. Combination of yam with cassava or yam and cassava with vegetables (onion).

d. Combination of plantain with maize or yam.

e. Combination of tomatoes and other vegetables like pepper, and garden-eggs.

Source: Author's Compilation from NWO Survey (2003).

Unlike maize, yam acreages of owner-cultivated households were higher than migrant farm households. In Nkoranza, migrant farm households did not cultivate cassava and beans as single crops. Yam and cassava are tuber crops and starchy staples in Ghana. Owners did not cultivate onion as a single crop. Groundnuts were grown in both districts by owners and migrants but tomatoes were grown as single crop only in Techiman. In some settlements within the transition zone of Brong Ahafo where men and women have separate plots, cassava and maize are more likely to be cultivated by men while groundnut is mainly a women's crop (Amanor *et al.*, 2002).

The proportions of sharecropping plots under maize and cassava cultivation were higher than fixed-rent plots (Table 5.2). However, yam was cultivated more on fixed-rent plots than on sharecropped plots. Generally, the proportion of legumes and vegetables sharecropped were low compared to those grown on fixed-rent plots. Sorghum and millet are savanna crops grown predominantly in Northern Ghana. Migrant households which cultivated these crops did not sharecrop them but cultivated them on fixed-rent plots. Fixed-rent plots were used for all the crops cultivated by Upper East migrant farm households in Techiman and Nkoranza.

Table 5.2. Crops Cultivated on Plots Acquired under Tenancy Contracts

Crops	% Fixed-rent plots	% Sharecropped plots
Maize	53.3	56.4
Yam	15.9	11.2
Cassava	6.6	15.4
Sorghum	1.2	
Millet	0.3	
Rice	2.7	1.6
Beans	3.6	3.7
Groundnuts	6.3	2.7
Pepper	1.5	1.1
Tomato	3.6	1.1
Okro	0.3	0.5
Garden eggs	1.8	1.1
Onions	1.8	0.5
Plantain	0.3	2.1
Cocoyam	0.6	2.7
Water melon	0.3	

Note: Figures are proportion of rented plots under the various crops
Source: Author's Compilation from NWO Survey (2003).

One strategy of increasing the profitability of some crops is to reduce input costs and employ good management practices that protect the soil by intercropping it with legumes and applying mulch on the soil. Long-term intercropping of crops with legume builds the soil, provides natural reserve of nitrogen for subsequent crops and also reduces nutrient leaching (sustainable farming practices will be revisited in Chapter 8). The most significant intercrop mixtures were cereal-based and legume-based intercrops. With the exception of cereal-based intercrops, proportions of owner-cultivated plots under other intercrop mixtures were higher than those of migrants. The value of income generated from crop outputs are summarised in Table 5.3. The food crops which provided the highest gross incomes per acre were onion, groundnuts, tomatoes and yam. With the exception of beans, the bulk of crop receipts to the households were from the minor season. In 2003, the mean gross crop income per acre for maize growers was ¢ 655,000 (US$77) and ¢3,344,000 (US$393) from onion.

5.1.2. Sale of Farm Produce

Not all crops produced by the households in 2003 were sold or consumed. Some were stored to be consumed later, used as seeds in the next planting season or stored purposely for improved prices. Hence about 38 percent of maize and 29 percent of the

Table 5.3. Distribution of Income from Crop Outputs

Crops	Gross Income in thousands (¢/acre)		
	Major season	Minor season	Total
Maize	413	242	655
Yam	435	605	1,040
Cassava	381		381
Beans	566	321	887
Groundnuts	306	946	1,252
Onion	1,294	2,050	3,344
Tomatoes	556	851	1,407

Note: Incomes are in Ghanaian Cedis (¢), Exchange rate: US$1= ¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

groundnuts produced in 2003 were stored. Beans, groundnuts, onion, and tomatoes were grown for cash rather than for subsistence purposes (Table 5.4). The levels of cassava and yam consumption among the farm households were also high.

Table 5.4. Migrant Household's Use of Crops

Crops	% sold	% stored	% consumed
Maize	53	38	9
Yam	79	3	18
Cassava	71	2	27
Beans	68	25	7
Groundnut	65	29	6
Onion	74	21	5
Tomatoes	95	3	2

Source: Author's Compilation from NWO Survey (2003).

Some of the households were autarkic, buyers, and/or sellers in the product market for agricultural goods. In Table 5.5, about 95 percent were sellers of crop outputs and 52 percent were buyers of food commodities. Although the majority of the households were maize growers, some food purchases were made from the market. Only 2 percent were self-sufficient in food production while 49 percent were both sellers and buyers of food.

Higher profit margins for food commodities depend on proactive marketing and sound financial planning. Marketing constraints in particular, have direct impact on measured crop income and may reduce the overall on-farm income to the household. Lack of profitability from crops could stem from factors such as input costs and prices received for food commodities. In Brong Ahafo, food crop producers have little control over prices of their commodities. Food markets are free from public intervention and producer prices of food are market-determined. In essence, farmers become "price takers", in that they take what they can get for their crops. Techiman is a feeder market for food commodities between the southern and the northern part of

Ghana. Hence prices of food commodities in Techiman significantly influence prices of local markets such as Bolgatanga in the Upper East (Abdulai, 2000).

Table 5.5. Participation of Migrant Farm Household in the Food Market

Market Regime	Techiman (%)	Nkoranza (%)	Total (%)
Sellers	96	93	95
Buyers	50	56	52
Only selling	50	41	46
Only buying	3	4	3
Selling and buying	46	52	49
Autarkic	1	3	2

Source: Author's Compilation from NWO Survey (2003).

Households that sold food commodities in 2003 did so either on the farm, at home, and/or at designated local markets. In Techiman, about 75 percent of the households sold their maize on the local market whilst 33 percent did so in Nkoranza. Farmers usually sell their farm produce directly to wholesalers with whom they have long-standing relationships. In addition, there are middlemen, petty traders and market queens who dominate the market and do their purchase at home or on the farm, and who often quote low prices for food commodities.

The main constraints to the sale of farm produce were high transportation costs, arbitrarily fixing and fluctuations in prices, difficulty in getting buyers and lack of storage facilities. About 50 percent of the households in Techiman and 88 percent in Nkoranza cited low output prices as the main constraints to the sale of food commodities. High transportation costs and long distances traders had to travel to Nkoranza to purchase food items may have explained the high incidence of low product prices to farmers in the district. Unlike Techiman, food markets are sparse in Nkoranza so farmers usually encounter difficulty in getting buyers and discover trading opportunities.

Commodities that recorded high marketing costs were maize and tomatoes. Net prices for onions and beans were the highest. Marketing costs for maize constituted about 4 percent of its selling price while 5 percent and 6 percent of marketing costs of yam and cassava constituted the selling prices of those commodities. The relatively moderate marketing costs may explain why the majority of the households sold their farm produce on the market. The marketing costs incurred on food commodities comprised of transportation, tolls, loading and shelling costs. Farmers paid tolls as tax to local authorities in the designated local markets where they sold their farm produce. The cost of transportation alone was about 86 percent of the marketing costs while toll costs totalled about 8 percent.

At the peak of harvesting seasons, lack of storage facilities compels farmers to dispose of their food commodities even when food glut prevails in some designated local markets. Although farmers may wish to patronise silos provided by some NGOs, the high overhead charges associated with the use of the silos tend to

discourage them (MTDP-NDA, 1996-2002). In general, high transportation costs, poor price information, and commodity perishability tended to cause a wide range of price fluctuations for food commodities in Techiman and Nkoranza.

5.1.3. Factor Allocations over Crops

Farmers allocate labour to a particular crop after land has been fixed. Apart from hired farm labour, farm households depend on family labour in their agricultural production. Farm households with available family labour resources incur lower monitoring costs because where farm labour is hired, family labour is used in supervision. Wives and children, and sometimes close relatives and friends increase their on-farm labour hours during peak demand periods to assist the household to overcome labour bottlenecks.[8] Upton (1996) has noted that the welfare of farm households would improve if employing labour productively and more evenly throughout the year increases the total product of family labour and production unit of peak-period.

This Section describes how the farm households allocated land and labour to crops. In Table 5.6, land and labour profiles differed for single crops and intercrop mixtures. More acreage was allocated to maize than all the single crops cultivated by the households. Land allocations to cereal-based and legume-based intercrops were also significant. With the exception of maize, yam and onion, hired labour input exceeded family labour input on all plots where crops appeared as single crops. However, family labour input for intercrop mixtures were generally higher than hired labour input.

5.1.4. Economic Returns of Crops

The attractiveness of a particular crop to the farm household depends on its economic returns. The economic returns represent the relative contributions of the crop at the margins. How profitable the crop is at the margins is influenced by the amount of land and labour employed in producing the crop. It was found from the previous section that factor allocations over single crops were different from intercrop mixtures. This follows logically that the economic profitability of growing single crops will not be the same as growing intercrop mixtures. Hence in this section, we intend to use the net returns per acre and net returns per family labour to show whether it was economically profitable for the migrant farm households to grow single crops or intercrop mixtures.

[8] When family friends and relatives put their labour services at the disposal of the household head during peak agricultural seasons, they also expect such assistance in return. This type of labour assistance where no monetary transaction takes place but the household head reciprocate by offering his labour (and that of his family) services in return is referred to as *'nnoboa'*.

Table 5.6. Annual Factor Allocations over Crops

Crops	Land (acre)	Hired labour (man-days)/(acre)	Family labour (man-days)/(acre)
Single crops			
Maize	514	12	15
Yam	34	21	12
Cassava	25	9	7
Beans	39	4	7
Groundnuts	24	13	6
Onion	12	11	12
Tomatoes	11	21	10
Intercrop-mix			
Cereal-based	319	12	16
Legume-based	133	16	16
Yam-cassava	50	13	12
Plantain-based	71	9	8
Vegetable-based	3	18	26

Source: Author's Compilation from NWO Survey (2003).

The net return per acre was calculated by dividing the net value of production and variable costs by area allocated to the crop. The value of production is the product of the yield and output price. Variable costs include the costs of hired labour and variable inputs such as fertiliser, seeds (improved seeds and planting materials) and chemicals (herbicides and insecticides). Similarly, the net return per family labour days were calculated by dividing the net of the value of production and variable costs by the family labour days in producing the crop. Crop output was measured in kilogram (kg) and crop area in acres. The yield or productivity was measured in kilograms per acre (kg/acre) and output prices (selling) of the crops in Ghanaian Cedis per kilogram (¢/kg). The variable costs were measured in Ghanaian Cedis per acre (¢/acre). Family and hired labour inputs were measured in man-days. The returns from growing single crops are shown in Table 5.7. Farm households that cultivated onions, tomatoes and groundnuts as single crops received the highest net return per acre. The gross return per acre for yam was high but its net return per acre declined due to high costs of labour and planting materials. In terms of net returns per family labour day, households that cultivated groundnuts as single crop recorded the highest return while cassava growers received the lowest return. Apart from factor allocations over crops, the observed differences in the yields and economic returns could stem from factors such as plot-level characteristics, farmer management and agro-climatic effects.[9] In particular, low rainfall recorded in the Brong Ahafo Region during the beginning of the major cropping season in 2003 may have translated into yield losses for households that cultivated maize as single crop.

[9] Walker and Rao (1982) have explained the sources of yield and net return variations in crops with data from six Indian villages. They attributed the variations in crop yields to cropping year, agro-climatic and biological risks, the strength of the farmer and/or the strength of the field. For economic returns, they cited the differences in farm household's resources such as family labour endowment and owned draft power.

Table 5.7. Estimates of Economic Returns from Single Crops

Crops	Maize	Yam	Cassava	Beans	Groundnut	Onion	Tomatoes
Area (acres)	514	34	25	39	24	12	11
Family labour (man-days)	7,570	393	187	252	141	138	110
Price (¢/kg)	839	834	630	1,975	1,755	1,396	2,246
Output (kg)	239,100	31,330	4760	4,851	8,569	9,344	3,796
Yield (kg/acre)	466	935	190	126	357	779	362
Costs (¢/acre)	181,762	498,955	92,920	55,091	177,083	510,500	308,095
Gross return (¢/acre)	390,683	780,293	120,000	248,773	626,750	1,086,667	811,904
Net returns (¢/acre)	208,920	281,337	27,080	193,682	449,667	576,167	503,809
Gross return ¢/(man-days)	26,501	66,513	16,043	38,007	106,681	94,493	77,500
Net returns ¢/(man-days)	14,172	23,982	3,620	29,590	76,539	50,101	48,091

Note: Estimates of economic returns are for pure stands only. 1bag of maize =100kg; 1 average tuber of yam =2.6kg; 1taxi boot of cassava = 280kg; 1bag of beans =109kg 1bag of groundnut = 82kg; 1bag of onion =73 kg and 1box of tomatoes = 52kg.

Returns are in Ghanaian Cedis (¢), Exchange rate: US$1= ¢8500 in 2003.

Source: Author's Compilation from NWO Survey (2003).

Estimates of net returns for intercrop mixtures are provided in Table 5.8. Area cultivated and family labour days were not proportional in the intercrop combination as they were for crops in pure stands. The economic returns for maize improved when it was intercropped with yam and other cereals like sorghum but its economic profitability decreased when it was cultivated together with cassava. Similarly, the net return per acre for yam increased in groundnut-yam and plantain-yam intercrops. Plantain is a perennial crop which does not require much investment in labour and purchased inputs. Hence inputs use was probably skewed towards yam, which is a relatively more labour-intensive crop. Also the profitability of growing groundnut in a groundnut-yam mixture was better than growing it as a single crop. Apart from maize, yam and groundnut, the relative profitability of the other crops did not improve much. Hence it was economically more attractive for the households to cultivate those crops in pure stands than to combine them with other crops. In Northern Nigeria, return per unit of peak labour input for crop mixtures was found to be higher than single crops (Norman, 1969) but Upton (1996) argued that crops need not always be grown in mixtures to achieve desired returns.

Table 5.8. Estimates of Economic Returns from Intercrop Mixture

Intercrop mixtures	Hired Labour (man-days) /(acre)	Family Labour (man-days) /(acre)	Costs ¢/(acre)	Gross returns ¢/(acre)	Net returns ¢/(acre)	Gross returns ¢/(man-/days)	Net returns ¢/(man-/days)
Cereal-based							
Maize-yam §	14	18	263,821	940,599	676,778	53,443	38,453
Maize-cassava	11	27	190,825	387,146	196,320	14,213	7,208
Maize-sorghum §	24	9	307,500	883,180	575,680	102,398	66,746
Maize-tomatoes	10	7	240,852	819,848	578,996	114,103	80,582
Legume-based							
Beans-maize-yam	10	33	255,250	1,161,331	906,081	35,281	27,527
Beans-tomatoes	11	7	308,889	653,174	344,285	90,439	47,670
Groundnut-maize	14	14	183,750	581,612	397,862	42,534	29,096
Groundnut-yam	12	15	425,714	2,429,586	2,003,871	160,444	132,331
Groundnut-tomato	7	7	140,000	562,970	422,970	76,077	57,158
Yam-cassava							
Yam-cassava	18	18	369,312	710,694	341,381	40,323	19,369
Yam-cassava-Onion‡	27	14	351,667	400,000	48,333	27,907	3,372
Plantain-based							
Plantain-maize §	13	11	228,351	324,553	96,202	30,248	8,966
Plantain-yam †	6	10	171,400	775,993	604,593	74,615	58,134
Plantain-maize-yam	7	4	461,667	900,000	438,333	225,000	109,583
Vegetable-based							
Tomatoes-garden eggs-pepper♀		5	12,750	188,542	175,792	39,693	37,009

Note: § Gross returns calculated from maize output only, † Gross returns were from yam output only. ‡ Gross returns calculated from onion output only. ♀ Gross returns from tomatoes output only.
Returns are in Ghanaian Cedis (¢), Exchange rate: US$1= ¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

5.2. Labour Inputs

Efficient allocation of time endowments of members of the households is an important aspect of their agricultural production. Farm households rely on multiple sources of income but the preferences to work on-farm or off-farm have different utility implications which are determined by returns from time allocation to these activities (Lopez, 1984). In most rural settings, farm households do not work only on-farm but allocate some of their time endowments simultaneously to off-farm work usually as hired casual labourers in other people's farm during slack periods of

agricultural production or engage in part-time off-farm self-employment activities. Increased income from non-farm sources rather than farming may be responsible for improved real income levels. Huffman (1980) has noted that cash constraints of most farm households may be reduced with increased participation in off-farm work which assists in the purchase of productivity enhancing inputs.

Some farm households could also earn more by working on-farm than to hire their labour out in other people's farm. In that case, they neither hire-in labour nor hire their labour services out. Furthermore, since hired farm labourers have the propensity to shirk, they need to be supervised and therefore, the labour time that can be hired on the market is only an imperfect substitute for one's own time. The main objective of this Section is to explore the labour allocations of the farm households. The labour inputs for specific farm operations in food crop production are therefore discussed. The Section which follows investigates the household's demand for hired labour on the farm.

Agricultural production activities are usually spread over time so the farm households could plan and operate efficiently based on their labour and working capital endowments. Given the increasing marginal costs of the farmer's own time, he could hire in labour but this must be supervised to avoid moral hazards on the part of hired workers. Family members could be motivated to provide supervision with the view that hired labour would be more efficient and provide more labour services per unit of time. Female family labour was used in almost all farm operations because they performed other farm tasks such as stumping and weed control during supervision of hired farm labour (see Table 5.9). The gender division of labour among the farm households however did not change much from what Whitehead (1996) found in the Bawku-East District of the Upper East Region. In some parts of Southern Ghana, Bortey-Doku (1990) also finds that women and children were used in almost all post-harvest management activities of food crops. Male hired labour input among the farm households increased for land preparation, weed control and harvesting. Hired labour inputs by women on the other hand, increased in less-labour intensive tasks like sowing (planting) and harvesting. Typical casual hired labourers in Brong Ahafo include the year-round migrant labourers, seasonal migrant labourers and other part-time labourers. Casual hired labourers were engaged either on daily or contractual basis where fixed cash wages are paid. Mean wages in the major season generally exceeded that of the minor season and on the average, hired labour wage was about ¢10,000 (US$ 1.18) per day (Table 5.10). Mean wages for casual hired labourers were not 'actual' wage rates. The 'actual' wages to casual agricultural labourers in Ghana comprises of a fixed money wage and other fringe benefits such as food (in-kind or meals).

Table 5.9. Annual Mean Family Labour Input

Farm Operations	Male		Female	
	Percent use	man-days	percent use	man-days
Major season				
Land preparation	21	12	11	9
Sowing/planting	26	7	38	5
Weed control	24	12	13	9
Harvesting	29	10	39	10
Total	100	41	100	33
Minor season				
Land preparation	18	12	10	8
Sowing/planting	30	5	40	5
Weed control	27	9	16	10
Harvesting	25	9	33	10
Total	100	36	100	33

Source: Author's Compilation from NWO Survey (2003).

Table 5.10. Annual Mean Hired Labour Input

Farm operations	Male			Female		
	percent use	Man-days	wage (¢)	percent use	man-days	wage (¢)
Major season						
Land preparation	40	25	10,731			
Sowing/planting	9	11	10,038	78	9	10,570
Weed control	35	18	11,960			
Harvesting	16	12	11,611	22	11	10,304
Total	100	65		100	20	
Minor season						
Land preparation	38	20	10,547			
Sowing/planting	13	19	9,581	83	10	10,979
Weed control	41	22	11,607			
Harvesting	9	17	11,056	17	15	7,636
Total	100	78		100	24	

Note: Wages are in Ghanaian Cedis (¢), Exchange rate: US$1= ¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

5.3. Demand for Hired Farm Labour

The household model developed in Chapter 4 considered the migrant farm households as producers and consumers of agricultural and market goods in which labour demand and supply decisions were combined in one theoretical framework. In the literature, the analysis on time allocation of farm households has frequently focussed on the household's supply of labour with little or no analytical investigation on the demand for hired farm labour. In this Section, hired labour use by the farm

household is modelled as a decision variable, an approach which is consistent with other existing studies (Huffman, 1980; Findeis and Lass, 1994; Benjamin *et al*., 1996; Sadoulet *et al.*, 1998) and where the interrelationship between demand for hired labour and off-farm labour supply are examined together. The main objective in this Section is to deduce the reduced form equations for demand and supply of labour assuming that an interior solution exists in the theoretical model formulated in Chapter 4. The next task is to undertake an empirical analysis on the household's demand for hired farm labour. The household's off-farm labour supply will be investigated thoroughly in Chapter 6.

5.3.1. Theoretical Considerations

Recall that the demand for rented land was expressed in a reduced form as:

$$D_j = D(w^N, w^H, p_C, p_X, p, \overline{Y}; z, \psi) \tag{5.1}$$

and that the total time endowment of the household L^O was given as:

$$L^O = L^F + L^N + L^L + sL^H \tag{5.2}$$

Now, if the total time demand for farm work is $L^{FM} = L^F + sL^H$ and L^N denotes the time supplied by each household member to off-farm work, then (5.2) can be re-arranged in the form:

$$L^N = L^O - L^{FM} - L^L \tag{5.3}$$

The reduced form representation for demand for leisure then is:

$$L^L = L(w^N, w^H, \overline{Y}, p_C, p_X, p; z, \psi, L^O) \tag{5.4}$$

and the demand for total farm labour is stated in reduced form equation as:

$$L^{FM} = L(w^N, w^H, \overline{Y}, p_c, p_X, p; z, \psi) \tag{5.5}$$

Similarly, the demand for hired farm labour is also expressed in reduced form as:

$$L^H = L(w^N, w^H, \overline{Y}, p_C, p_X, p; z, \psi) \tag{5.6}$$

Now, substituting (5.4) and (5.5) into (5.3) and re-arranging gives a reduced form equation for the household's time allocation to off-farm work as:

$$L^N = L(w^N, w^H, \overline{Y}, p_C, p_X, p; z, \psi, L^C) \tag{5.7}$$

5.3.2. Estimating the Model

To explore the determinants of hired farm labour use, attention is paid to the reduced form (5.6) which specifies the variables that affect the decision to hire-in labour on the farm. Benjamin *et al.* (1996) estimated a similar model with the probit of participation rather than work hours of hired farm labour with the idea that households could either employ seasonal or permanent workers as hired hands on the farm. The present study employs the actual hours worked by hired hands as the dependent variable in an instrumental variable approach where off-farm wage rate and livestock wealth (measure of household wealth) are considered endogenous and instrumented with the number of children of the farmer, dummies for religion, veterinary visits, and off-farm participation of the wife. The household characteristics included in the labour demand model are the farmer's age, years of formal education, duration of stay and household size. The farm characteristic used is the amount of sharecropped land (acres). Other exogenous variables included are non-labour income and village-level wage rates.[10] Some village-level dummies are included to capture the effects of local market characteristics on demand for hired farm labour.

5.3.3. Empirical Results of Demand for Hired Farm Labour

Table 5.11 provides estimated results of demand for hired farm labour by Upper East migrant farm households in Brong Ahafo. Descriptive statistics are provided in Annex 5.1. Hired farm labour use has a significant inverse relationship with sharecropped acreages. The empirical result confirms the Marshallian argument that the marginal product of labour on sharecropped plots is lower than other plots and that households with sharecropped plots tend to depend less on hired farm labour.

Table 5.11. Estimated Results for Hired Farm Labour Demand
Dependent Variable: Hired Farm Labour Hours

Variable	OLS		IV	
	Coefficients	t-ratio	Coefficients	t-ratio
Constant	3.9262	1.92 *	4.2072	1.93 *
Sharecropped land	-0.0865	-2.82 ***	-0.0735	-2.07 **
Village-level wage rates	-0.2433	-1.87 *	-0.2697	-1.79 *
Off-farm wage rates†	0.0152	2.28 **	0.0671	1.27
Livestock wealth†	0.0016	1.06	0.0044	0.54
Non-labour income	-0.0222	-0.27	0.0140	0.15
Age	-0.0329	-0.72	-0.0324	-0.70
$(Age)^2/100$	0.0357	0.76	0.0378	0.80
Education	-0.0408	-0.73	-0.0375	-0.65

[10] Preliminary empirical investigations with output prices such as maize and yam, and input prices of fertiliser did not give any consistent estimates so the variables have been discarded from the present analysis.

(Education) ^{2}	0.0076	1.84 *	0.0077	1.90 *
Duration of stay	0.0774	4.36 ***	0.0697	3.72 ***
(Duration of stay)^2	-0.0014	-3.95 ***	-0.0012	-3.30 ***
Household size	0.0454	1.91 *	0.0193	0.60
Twimea-Nkwanta	-0.1105	-0.29	-0.0191	-0.04
Aworopata	-1.4199	-2.15 **	-1.4919	-1.92 *
Woraso	1.5596	4.01 ***	1.7019	3.76 ***
Dromankese	-0.2666	-0.88	-0.1429	-0.41
R^2		0.2593		0.0907
Wu-Hausman		4.73		3.43
Number of observations		181		181

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.
†Shows variable instrumented in the production function.
Source: Author's Compilation from NWO Survey (2003).

The significant negative coefficient of village-level wage rate also agrees well with the inverse relationship proposed by Bardhan (1984) for rural Indian data. The coefficient of off-farm wages and livestock wealth had the anticipated signs but none was significant even at 10 percent indicating statistically that households with less cash constraints employ more hired farm labour. The empirical results however are suggestive that farm households with enough liquid wealth and off-farm sources of employment are capable of employing more hired hands on the farm. Moreover, the coefficient of duration of stay is positive and statistically significant lending credence to our earlier assertion that duration of stay allows migrant farm households to accumulate enough cash to finance farming activities such as hiring-in of labour on the farm. The coefficient of household size is positive and significant in the OLS estimation but not in the IV model, suggesting that hired and family labour are perhaps perfect substitutes in agricultural production of the migrant farm households. Although not significant, variables such as age and education which explain the effect of managerial abilities of the household on hired farm labour use had the correct hypothesised signs.

5.4. Production Function

An important consideration in understanding the structure of farm income within farm households is to determine the contributions of individual factors of production. To analyse the production relationships of the farm households, a Cobb Douglas production function was fitted to the farm household data. Many of the sampled farm households recorded low use of chemical fertilisers and other inputs such as herbicides, pesticides and improved seeds (planting materials). Preliminary investigations with the translog and quadratic forms of production functions did not produce the desired theoretical results due to high incidence of zero observations in those inputs. Moreover, it is not a recommended statistical methodology to drop variables with high incidence of zero observations from the model as the estimates could suffer from omitted bias problem. So to capture the effects of variable physical

inputs on the household's productivity, the revenue or value-added production function was used in the estimation.

5.4.1. Specification of Production Function

The value added production function was specified as:

$$\ln\left(Q_i - \sum_{r=1}^{M} I_{ir}\right) = \sum_{j=1}^{N} \lambda_j \ln X_{ij} + \sum_{k=1}^{H} \delta_k V_{ik}^{d} + \mu_i \qquad (5.8)$$

where the dependent variable $\left(Q_i - \sum_{r=1}^{M} I_{ir}\right)$ is the value-added total agricultural output produced by farm household i, I_{ri} is a vector of expenditure on variable purchased inputs r such as fertiliser, seeds (planting materials) and chemicals (herbicides and insecticides) used by farm household i, X_{ij} denotes vector of factor inputs j namely land, labour (hired and family hours)[11] and capital, and V^d denotes village-level dummies, which capture measured differences across villages.

Livestock wealth was used as a proxy for the household's capital. The household's management inputs in agricultural production were education and age of the farmer. The effect of quality of cultivated land on agricultural production was controlled by the share of the household's land area under forest vegetation. Variables treated as endogenous in the production function were livestock wealth[12] and farm labour hours (hired plus family). The identifying instruments for livestock wealth and farm labour hours were village-level average wage rates, children of the farmer and dummies for veterinary visits, other household members or wife in off-farm employment, and dummy for households that cultivated food crops on taungya plots.

[11] Hired and family labour inputs did not enter the equation as separate factors of production because of assumption of perfect substitutability between hired and family labour. Moreover, preliminary empirical investigations did not produced consistent estimates.

[12] This approach departs slightly from Jacoby's (1992) study in which total output was measured as crop output plus value of livestock. Pure crop production is assumed in our model by allowing livestock wealth to enter the production function as a separate endogenous variable. Livestock as wealth indicator influenced amount of land cultivated by the households. Land input production represents the acreage at the disposal of the farm households during period of cultivation.

5.4.2. Empirical Results of Production Function

The estimated coefficients of the production function with t-statistics are presented in Table 5.12. Descriptive statistics of the variables used in the estimation of the production function are provided in Annex 5.1. The mean value added output was 3.36 and standard deviation was 3.22. To test whether the instrumental variables were truly exogenous, the Wu-Hausman test was employed. The small *p*-value of the joint significant of the variables indicates that OLS was inconsistent and that the instruments were appropriate. The presence of heteroskedasticity in the data was checked with the combined Cook-Weisberg (1983) and Breusch-Pagan test. The heteroskedasticity test examines if $\theta = 0$ in the equation $\text{var}(\mu) = \sigma^2 \exp(\theta \hat{q})$, where μ is the error term in the specified production function in (5.1) and $\hat{q}$ is the fitted value of the dependent variable. The test is a chi-square (χ^2) distribution with a null hypothesis that μ has a constant variance. The computed (χ^2) statistics of 9.21 with a corresponding *p*-value of 0.0024 revealed some amount of heteroskedasticity in the data. The assumption of independence of the observations was then relaxed so that robust variance estimates could be obtained (White, 1980). Hence the empirical results reported are heteroskedasticity consistent.

The coefficient of land is estimated to be positive and significant in the OLS and IV estimations indicating empirically that land input was associated with higher levels of value-added agricultural output. The 0.39 coefficient for land suggests that 39 percent of the value-added may be attributed to the factor land. This also compares reasonably well with the share taken by the landlord in a sharecropping contract. The farm labour elasticity is estimated to be about 0.53. Hence, a 1 percent increase in farm labour hours within the sampled households corresponds to 0.53 percent increase in the value-added output. Statistically, the coefficient associated with livestock wealth had positive significant impact on the household's productivity, an empirical result which lends credence to the importance of capital to the productivity of the migrant farm households. Those with cash constraints could not purchase enough productivity improvement inputs. The high incidence of tenancy arrangements and possible excessive land rents might have discouraged them from generating sufficient surplus over consumption requirements needed to purchase productivity enhancing inputs that would have raised their income levels through food crop production.

Table 5.12. Cobb-Douglas Production Function Estimates
Dependent Variable: Log Value-Added Output

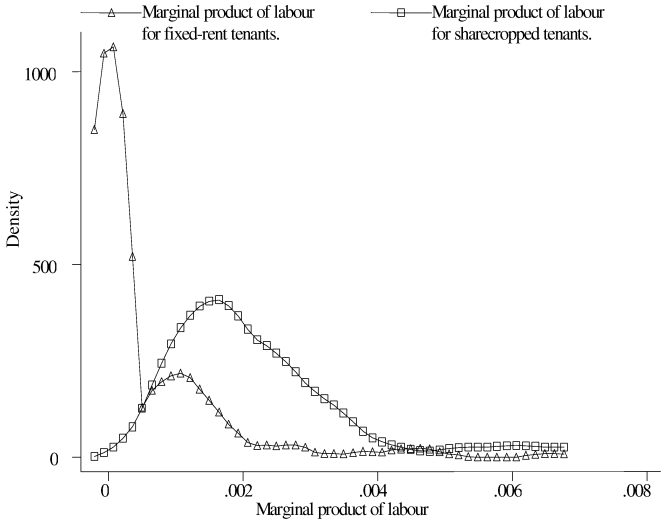
Variable	OLS		IV	
	Coefficient	t-ratio	Coefficient	t-ratio
Constant	-1.5213	-1.94 *	-3.3063	-1.86†*
Log land	0.6318	3.78 ***	0.3956	1.79†*
Log farm labour †	0.2046	1.54	0.5314	1.65†*
Livestock wealth †	0.0049	2.90 ***	0.0123	1.78†*
Age	-0.0034	-0.57	-0.0048	-0.77
Years of formal education	-0.0141	-0.80	-0.0011	-0.06
Share of forest land	0.0028	0.09	0.0259	0.71
Aworopata	-0.2425	-1.20	-0.4851	-1.74†*
Nkwaeso	0.5755	3.02 ***	0.5834	2.49†***
Dromankese	0.2894	1.10	0.1330	0.43
R^2	0.2822		0.2207	
Wu-Hausman	9.13		6.44	
Marginal product of labour	0.0009		0.0028	
Number of observations	181		181	

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.
†Shows variables instrumented in the production function.
Source: Author's Compilation from NWO Survey (2003).

The coefficients associated with managerial inputs however do not appear to have any consistent and significant influence on the value-added output of the farm households. The coefficient of the share of cultivated land under forest vegetation appears to have no significant effect on the value-added agricultural output. The null hypothesis, $H_0 : \lambda_L = 0$ which specifies that farm labour input (family plus hired) has zero coefficients in the model was also tested. The *F*-value of 2.74 and *p*-value of 0.0997 suggest that the null hypothesis can be rejected. Given the existing technology within the households, it can be concluded that family and hired labour were equally important in the agricultural production of the migrant farm households.

The marginal product of farm labour ($\hat{w}^L$) was calculated from the estimated production function as $\hat{w}_i^L = \hat{\alpha}_i^L \hat{q}_i / L_i$ where $\hat{q}_i$ is the predicted estimate of value-added agricultural output $\left(Q_i - \sum_{r=1}^{M} I_{ir} \right)$. L_i and $\hat{\alpha}_i^L$ denote farm labour (hours) and parameter estimate of farm labour respectively. Sharecroppers receive less than their marginal product of farm labour. Hence, their marginal product is derived as $\hat{w}_i^{LS} = \hat{\alpha}_i^L (1-\theta) \hat{q}_i / L_i$, where θ is the share parameter, and $\theta = 1/3$.

Figure 5.2. Kernel Density Plots of Marginal Products of Farm Labour



Source: Author's Compilation from NWO Survey (2003).

The marginal products of households with fixed-rent and sharecropped plots are illustrated with kernel density estimates in Figure 5.2. Density estimates for farm households with fixed-rent plots appear to have multiple peaks of declining densities as the distribution skews towards the right tail. Density estimates for sharecroppers however have a unimodal peak and a smoother curve with lower kernel density estimates than farm households with fixed-rent contracts. What these suggest is that different groupings within the households with fixed-rent contracts had marginal products that were different in the distribution.

5.4.3. Simulating the Effects of Labour and Land on Agricultural Production

The empirical results reported in the previous Section show that labour and land have significant influence on the household's agricultural production. But the question is: How large are these effects on the value-added agricultural output? To answer this question, the instrumental variable estimation results are used to simulate the importance of labour and land. First, the baseline scenario was calculated using the estimated coefficients and the actual values of all variables used in the model. In the subsequent scenarios, instead of actual values, we move along the 10th to the 90th percentile of the distribution and calculate how much value-added output could be attributed to labour and land.

Table 5.13 gives the simulated results. Comparing the base run scenario with a scenario where the distribution for labour is halved, the corresponding change is about 0.8 percent whereas the net simulation is 4.4 percent at the median distribution for land. However the changes for value-added output were about 85 percent and 75 percent respectively when we move from the 10th to the 90th percentiles of the distribution of labour and land. These simulated results confirm the preposition that the household's income generation through crop production hinges so much on the amount of land cultivated and labour employed by the farm households.

Table 5.13. Simulations Showing the Importance of Labour and Land in Agricultural Production

	Value-Added Agricultural Output (000,000 ¢)					
Simulations	Base run (P_o)	10th Percentile (P_{10})	50th Percentile (P_{50})	90th Percentile (P_{90})	Net Simulated Effect (P_{50}-P_o)	Net Simulated Effect (P_{90}-P_{10})
Labour (man-days)	0.7155	0.2785	0.7239	1.1304	0.0084	0.8519
Land (acres)	0.7155	0.2829	0.7592	1.0334	0.0437	0.7505

Source: Author's Compilation from NWO Survey (2003).

5.5. Summary and Conclusions

The primary aim of Upper East migrant farm households in Brong Ahafo was to generate on-farm income from rented land. It has been investigated in this Chapter that the households were able to raise their income levels by growing food crops during the major and minor seasons of 2003. In terms of food crop production, there was not much difference between crops grown by migrants and those of indigenous landowners. The proportion of beans, groundnuts, onion and tomato plots sharecropped was lower than those grown under fixed-rent contracts. Similarly, maize and yam were cultivated on fixed-rent plots rather than on sharecropped plots because of their relative importance to the migrant farm households in terms of labour and capital inputs. Apart from food crops, owner-cultivators planted trees like teak, cashew, and oil palm but only migrant households with taungya plots could undertake tree planting. The mean income from on-farm work was ¢3,586,543 (US$334). The mean gross crop income per acre was ¢655,000 (US$77) for maize growers and ¢3,344,000 (US$393) for those who cultivated onion. The attractiveness of growing a particular crop depended on the economic return of the crop to the farm households. In particular, the relative profitability of staples like maize and yam were improved when they were combined with other crops such as plantain in intercrop mixtures. In terms of family labour days however, not much difference was observed in the net returns from growing single crops or intercrop mixtures.

Efficient resource allocation is required to stimulate better production systems necessary to generate on-farm income needed by the households. Hence, the farm

household's demand for hired labour was analyzed. Instead of the usual probit of participation procedure employed in most empirical studies, the present study employs the actual hours worked by hired hands in an instrumental variable approach where off-farm wage rate and livestock wealth were considered endogenous. Demand for hired farm labour was influenced by farm characteristics and that households with sharecropped plots tend to depend less on hired farm labour. There was an inverse relationship between hired farm labour and wages to hired farm labour. The empirical results also indicate a significant positive influence of duration of stay on the amount of hired farm labour demanded by the households. This empirical finding lends credence to our earlier assertion that duration of stay is linked to household's ability to accumulate enough cash necessary for the financing of farm activities such as hiring-in of farm labour.

We have also investigated the production relationships of the households with a value-added production function specified in a Cobb-Douglas functional form. This approach provided robust estimates because of the high incidence of zero observations in variable purchased inputs. The empirical results clearly indicated that rented land, farm labour (family and hired) and livestock wealth were relatively important in agricultural production of Upper East migrant farm households in the Brong Ahafo Region of Ghana. Statistically, land input was associated with higher levels of agricultural output and a 1 percent increase in farm labour hours corresponded to about 0.53 percent increase in value-added output.

Comparison of market wages with the marginal products suggests that the farm households could raise their income levels by considering other off-farm income opportunities. The next Chapter explores the off-farm income generation of the farm households.

Annex 5.1. Descriptive Statistics of Variables Used in the Estimation of Demand for Hired Farm Labour and Production Function

Variables	Mean	Standard Deviation
Value-added output (¢)	3.3588	3.2190
Total labour (man-days)	702.45	425.65
Hired farm labour (hours)	1270.81	1166.86
Land cultivated (acres)	5.66	4.07
Sharecropped land (acres)	2.08	2.34
Non-sharecropped land (acres)	4.33	4.02
Share of forest land (acres)	1.41	2.76
Livestock wealth (¢)	14.45	31.06
Off-farm wages	0.0029	0.0092
Wages rate to hired farm labour	0.0125	0.0020
Non-labour income	0.1283	0.5524
Expenditure on fertiliser (¢)	0.1129	0.2859
Expenditure on pesticides (¢)	0.0190	0.0883
Expenditure on herbicides (¢)	0.0607	0.1635
Expenditure on seeds (¢)	0.2109	0.3838
Age (years)	45.98	13.35
Education (years)	2.03	3.98
Adult children (> 15 years)	2.42	1.70
Non-adult children (<15 years)	0.88	1.39
Duration of stay (years)	13.75	10.26
If household has a taungya plot	0.15	0.49
If household received veterinary visits in 2003	0.38	0.49
If household is religious	0.66	0.47
If household is a member of ethnic association	0.61	0.49
If wife works off-farm	0.44	0.49
If understating was reached before migration	0.88	0.33
If farmer resides at Twimea-Nkwanta	0.19	0.40
If farmer resides at Nkwaeso	0.15	0.36
If farmer resides at Aworopata	0.09	0.36
If farmer resides at Ayerede zone	0.29	0.45
If farmer resides at Dromankese	0.11	0.31

Note: Values of agricultural output, value-added output, livestock wealth, and expenditure on variable inputs are in millions of Ghanaian Cedis (¢), Exchange rate: US$1= ¢8500 in 2003.

Source: Author's Compilation from NWO Survey (2003).

Chapter 6

Off-Farm Income Generation

The previous Chapters were devoted to how Upper East migrant farm households acquired land in Brong Ahafo for income generation from crop production. On-farm income generation is important but the time allocation of farm households is very responsive to economic opportunities available to them. A substantial proportion of the households essentially allocate part of their time endowments to off-farm work. The market participation by husbands was 61 percent whilst for wives, it was 42 percent. Moreover, the proportion of households with both couples in some form of off-farm employment was about 36 percent. If off-farm work was so important to the households, then how much was earned vis-à-vis earnings from on-farm work? What are the determinants of their off-farm work participation, and what determines the wages men and women in the farm households received from engaging in off-farm work? Moreover, why would the members of the farm household choose to work on the farm or off the farm? These are the pertinent questions this Chapter seeks to answer.

The literature finds differences between returns to labour for on-farm and off-farm work (Bequele, 1983; Clay *et al.*, 1995; Kelly *et al.*, 1996; Abdulai and Delgado, 2000). Wages are not equalised among these activities probably due to transaction costs or disutility associated with working off-farm, and other employment constraints prevailing in the labour market. Individuals in the farm household would therefore face different wage offer functions if they allocate their time endowments to wage employment (agricultural and non-agricultural) while those in self-employment would be influenced by their return functions. The wage offer functions determine the wages they receive as a compensation for any alternative employment they would have engaged in.

In the farm household not every husband or wife participates in off-farm work so the wages or returns we observe are for those who actually engaged in some form of off-farm work. To determine what wage or return each individual in the sample would face supposing he or she engages in off-farm work, first the determinants of wage employment and self-employment participation of husbands or wives are estimated with a probit model after which the inverse Mills ratio (IMR) is calculated from the probit estimates. Second, the wage offer functions for those who engaged in wage employment are estimated with the inclusion of the IMR (lambda). Similarly, the hourly return functions for self-employed husbands and wives are also estimated with the inclusion of their IMR. Third, the wages and returns for all husbands and wives in the sample are predicted from the wage offer and hourly return functions respectively. To address the extent of off-farm work participation by husbands and wives, a theoretical model on labour supply response of the farm households is formulated. The model explains that apart from wages and returns from farm and off-

farm work, other household and farm characteristics may play a role in determining the labour supply of husbands and wives. Employing a Tobit model, explanatory variables such as farm wage, the predicted off-farm wage and return, and other household and farm characteristics are used to investigate the labour supply response of husbands and wives in the farm household.

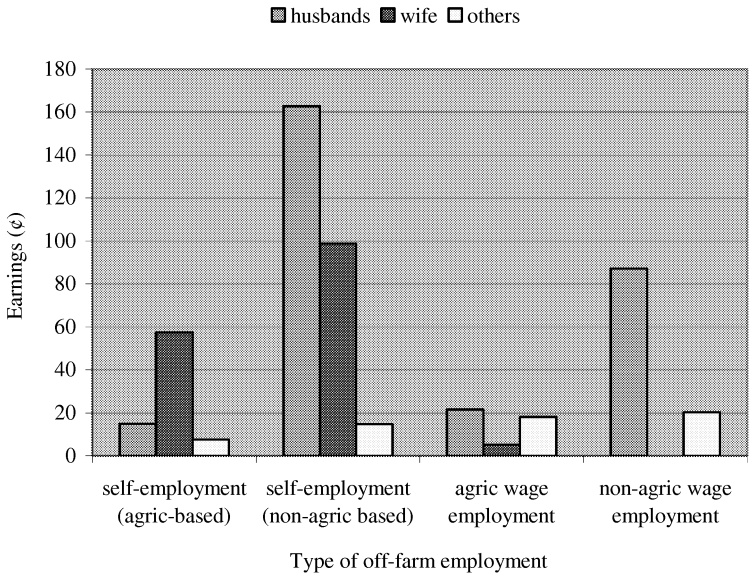
The Chapter is therefore planned as follows. Section 1 begins with a description of the nature of off-farm employment activities and quantifies the earnings from those employment activities. Section 2 is concerned with the estimation of the participation, wage offer and hourly return functions. The choice between on-farm and off-farm work is explained. Section 3 investigates the labour supply response of husbands and wives in the farm households. Section 4 offers some conclusions.

6.1. Off-farm Employment and Earnings

The farm households engage in self-employment (agricultural based and non-agricultural based) and wage employment (agricultural and non-agricultural) activities. Agricultural-based self-employment includes retail of foodstuffs and livestock, cooked food vending (women), brewing of pito (sorghum beer), gari (dried grated cassava) processing, and palm-kernel and palm oil processing (women). In the Nkoranza District, migrant couples in Dromankese brew pito (sorghum beer) to sell. Self-employed non-agricultural based jobs are vocational jobs (hairdressing and seamstress, and tailoring), handicrafts, charcoal burning, transport (drivers and truck pushers), artisans (masons, shoe repairers, bicycle repairers), and retail of sawn wood and essential commodities such as sugar, soap etc. Most couples at Twimea-Nkwanta in the Techiman District engage in handicrafts such as weaving of Muslim hats. Some households work as casual hired labourers in other people's farms for daily wages during slack agricultural seasons. The non-agricultural wage employments are low-skilled monthly salaried jobs such as night security work in government institutions like schools and banks, and in some private establishments like hotels, restaurants, petrol (gas) filling stations and retail shops.

Figure 6.1 shows how much was earned by the farm households from the off-farm employment activities in 2003. The income per farm from off-farm work is ¢2,840,976 (US$422) which compares favourably with on-farm earnings of approximately ¢3,586,543 (US$334). Migrant wives do not earn from non-agricultural wage employment. Salaried jobs available to the households such as night security jobs, driving of taxis and other commercial vehicles, and truck pushing are more suitable for men than women. The women however earned from casual hired farm work where they received daily wages. Table 6.1 gives the contributions by members of the households to off-farm earnings. About 70 percent of the earnings constitute self-employment income whereas agricultural and non-agricultural wage

Figure 6.1. Distribution of Earnings from Various Off-Farm Employments



Note: Off-farm earnings are in millions Ghanaian Cedis (¢); Exchange Rate: US$1= ¢8500 in 2003.
Source: Author's compilation from NWO survey (2003).

Table 6.1. Contributions of Off-Farm Earnings by Household Members

	Self-employment earnings		Agricultural wage employment earnings		Non-agricultural wage employment earnings		Total Earnings	
Household Members	¢	%	¢	%	¢	%	¢	%
Husbands	177	35	22	4	87	17	286	56
Wives	156	31	5	1			162	32
Others	22	4	18	4	21	4	61	12
Total	355	70	45	9	108	21	508	100

Note: Earnings are in millions of Ghanaian Cedis (¢). Exchange Rate: US$1= ¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

employment comprise of 9 percent and 21 percent respectively. The contribution of husbands in the total off-farm earnings was 56 percent. Migrant wives and other members living with the household head contributed 32 percent and 12 percent respectively of the total off-farm earnings. The off-farm earnings are indicative that off-farm work may be a secondary source of earnings to the farm households. The subsequent Sections seek to explore this possibility in detail.

6.2. Participation and Wage Equations

The objective of this Section is to explore the participation behaviour of husbands and wives in off-farm work. We therefore estimate their probability of off-farm work participation, wage offer function for wage employment and hourly return function for self-employment. Wage-labour participation decisions of individuals in the households are modelled by comparing their reservation and anticipated market wages (Tockle and Wallace, 1991). The market wage rate is the wage that employers are willing to pay to farmers who engage in off-farm work and the reservation wage is the wage below which the farmer would not want to work off-farm. The reservation wage is the marginal value of time when all of it is allocated to farm work and leisure. The value of marginal productivity on the farm may fall short of the wages from off-farm work due to transport and monitoring costs. Also if the individual is self-employed, differences may exist between his return from off-farm work and the marginal productivity on the farm probably due to inefficiency. Other employment constraints in the labour market could also be responsible for the inequality between the marginal product of labour and the returns to labour off the farm.

In Table 6.2 about 61 percent of husbands and 42 percent of wives participated in off-farm work. Self-employment participation by wives was higher than that by husbands but wage employment participation of husbands was higher than that of wives. Moreover, Tables 6.2 and 6.3 clearly demonstrate the existence of sample selection in the data because of non-participation in off-farm work by other husbands and wives. This selection bias need to be corrected (Heckman, 1979). To do this empirically, we estimate off-farm wages or returns for all husbands and wives who did not work off-farm by first employing a probit model to examine the determinants of their off-farm work participation after which, the inverse Mills ratio (IMR) is calculated. Second, the prediction of off-farm wages or returns for each husband or wife in the whole sample is computed after estimation of the selection wage or hourly return functions with inclusion of the IMR (lambda). Including IMR as an additional regressor in the models eliminates the potential selectivity bias. Moreover, the coefficient of IMR provides a consistent estimate of the covariance between the unmeasured characteristics in the participation and wage offer functions.

Table 6.2. Off-Farm Work Participation by Husbands and Wives

Off-farm work	Wife works (%)	Wife does not work (%)	Total (%)
Husband works	36	25	61
Husband does not work	6	33	39
Total	42	58	100

Source: Author's Compilation from NWO Survey (2003).

Table 6.3. Distribution of Off-Farm Employments of Household Members

Type of farm work	Husband (%)	Wife (%)	Others (%)	All (%)
Self-employment	21	30	2	18
Wage employment	33	11	18	21
Self-employment & wage employment	5	2	2	3
Non-participation	41	57	78	58

Source: Author's Compilation from NWO Survey (2003).

To examine the determinants of off-farm work participation of husbands and wives, it is important to revisit the theoretical model developed in Section 4.5 of Chapter 4 in which the households' off-farm labour time was expressed in a reduced form as:

$$L_i^N = L(w^N, w^H, p, p_X, p_C, \overline{Y}; z, \psi, \theta) \tag{6.1}$$

where w^N and w^H are the market wage and the wage rate to hired farm labour; p, p_X and p_C are the prices of outputs, purchased inputs and consumption goods respectively; $\overline{Y}$ denotes non-labour income; ψ and z represent the household and farm characteristics that affect production and consumption decisions, and θ is vector of location specific effects.

If market wage rates are observed for the households that worked off-farm then their participation decision (A_i) is specified as:

$$A_i^j = 1 \;\; if \;\; w_i^{Nj} \geq w_i^{Rj};\; A_i^j = 0 \;\; if \;\; w_i^{Nj} \leq w_i^{Rj} \qquad j = M,\ F \tag{6.2}$$

$$\begin{aligned} Pr(A_i^j = 1) &= Pr(w_i^{Nj} \geq w_i^{Rj}) \\ &= Pr(\delta' X_i^{\,j} + u_{1i}^j > 0);\; u_{1i}^j \sim N(0, \sigma_{1u}^2) \qquad j = M,\ F \end{aligned} \tag{6.3}$$

where $j = M$ for husbands and $j = F$ for wives; w^N and w^R are the market and the reservation wages respectively; X is a vector of variables that affect the market and reservation wage rates; u_{1i} is the error term.

The off-farm work participation decision of the farm household is influenced by a number of right-hand side variables indicated in reduced form equation (6.1). Hence the participation equation then becomes:

$$Pr(A_i^j = 1) = \Phi(w^N, w^H, p^*, \overline{Y}; z, \psi, \theta) \qquad j = M,\ F \tag{6.4}$$

where $\Phi(\cdot)$ is a cumulative distribution function and p^* is a vector of prices.

Any variable that explain the probability of wage work enter the individual's labour demand and labour supply functions, except the individual's anticipated wage rate. When the labour supply is upward sloping, the variables that cause the labour supply to shift to the left will increase the reservation wage and reduce the probability of wage work. Also a change in a variable that raises the market wage raises the labour demand curve and increases the probability of wage work.

Also if $A_i^j = 1$, then w_i^{Nj} is observed and the wage offer equation for an individual in the farm households is specified as:

$$w_i^{Nj} = \xi' X_i^j + e_i^j \ ;\ e_i^j \sim N(0, \sigma_e) \qquad j = M,\ F \tag{6.5}$$

where *X* is vector of variables that affects the market wage; ξ' is vector of parameters and *e* is the error term.

As already noted, selection bias occurs in the sample as a result of non-participation in self-employment or wage employment by husbands and wives. This problem needs to be corrected to avoid biasing the estimates. If we assume a bivariate normal distribution with a zero mean and correlation ρ for the error terms (u_{1i}) and (e_i) in the participation and wage offer equations, then according to Amemiya (1984) and Maddala (1983), the expected market wage rate, $E(w^{Nj})$ and the truncated market wage $E(w_i^{Nj} \mid A_i^j = 1)$ could be stated respectively as:

$$E(w_i^{Nj}) = \xi' X_i^j \Phi(c) + \rho_i^j \sigma_e \tau(c) \qquad j = M,\ F \tag{6.6}$$

$$E(w_i^{Nj} \mid A_i^j = 1) = \xi' X_i^j + \rho_i^j \sigma_e \, \tau(c)/\Phi(c) \qquad j = M,\ F \tag{6.7}$$

where $c = \xi' G/\sigma_{1u}$, σ is the standard error of *u*, $\tau(c)$ is the density function, $\Phi(c)$ is the cumulative distribution function and $\tau(c)/\Phi(c)$ is the inverse Mills ratio or lambda (λ).

Table 6.4 compares the returns to labour from on-farm and off-farm work of migrant husbands and wives. The ratio of returns farm work to off-farm work for husbands is 1:4 while that for wives is approximately 1:3. Compared to husbands, wives received lower wage employment wages. Various factors may have led to this occurrence. Agricultural wages for instance are influenced by labour productivity on the farm. Men can perform certain farm tasks better than women do and this may explain why women are paid lower wages than males for tasks where productivities of women may be low. Moreover, more arduous farm tasks such as bush clearing, construction of ridges and mounds etc., which attract higher wages, are performed better by men. Comparatively, the observed mean hourly return for self-employed husbands was thrice that of the wives while for the estimated returns, it was twice. Obviously, self-employment businesses for husbands such as retail of livestock, sawn wood, etc. are more lucrative and pay higher in value terms than self-employment jobs of wives such as cooked-food vending, gari (dried grated cassava) and palm kernel processing, etc.

Table 6.4. Returns to Labour from Farm and Off-farm Work

	Husband (N=181)				Wife (N=144)			
	Observed		Estimated		Observed		Estimated	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Farm wage (¢)	12546	2029.0			12694	2047.1		
Wage employment wage (¢)	4402	7716.2	9651	4411.8	1381	4103.1	10771	3097.1
Self-employment hourly return(¢)	4569	23695.4	7945	5455.6	2933	8435	2493	1916.3

Exchange Rate: US$1= ¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

6.2.1. Empirical Results of Participation and Wage Equations

The returns from off-farm work do not refer to wages from wage employment only, but to returns per hour from self-employment as well (Benjamin, 1992). Recalling from Section 6.1, husbands and wives engaged in lucrative self-employment activities apart from working in non-agricultural wage employments and as casual farm labourers in other people's farms. Hence, we estimate separate participation and wage offer equations for husbands and wives. We repeat the same estimation procedure for participation and hourly returns for self-employed husbands and wives. The self-employment hourly returns were computed by dividing the net of all self-employment earnings and all self-employment costs by the total hours of work. Agricultural and

non-agricultural wages were also calculated as weekly or monthly earnings divided by total hours of work.

The market wage rate depends on human capital of the household such as education, skills and experience that affect productivity of the farm household (Huffman, 1991). Age and years of formal education of husband or wife were used to proxy for experience and skills (Behrman and Wolf, 1984). Apart from the human capital variables, some selected variables are examined for their effects on the probability of off-farm work participation. These include exogenous household factors such as duration of stay, non-labour income (unearned), household size, and location (village) dummies. Since village dummies capture the differences in agricultural wage rates, the wage rate to hired farm labour was excluded from the participation model. Farm characteristics such as the amount of land cultivated (acres) and a dummy controlling for sharecropping households were included to examine their impact on participation. In addition to age and education, other exogenous variables included in the wage offer and hourly return functions were the IMR, and some location dummies.

Table 6.5 reports the probit estimates of self-employment participation by wives and husbands. The log likelihood test statistics were significant at 1 percent level, suggesting that the independent variables taken together influenced participation. The probability of self-employment participation of wives increases with age but at a mean age of about 35 years, self-employment participation of migrant wives starts to decrease. The statistical result confirms what Abdulai and Delgado (1999) found for rural farm households in Northern Ghana. The education variables for husbands and wives had the anticipated positive signs but the husband's education was not significant even at 10 percent, a result which is not surprising because of the low-skilled nature of off-farm employment opportunities opened to the farm households. However, education of migrant wives was positive and significant. In particular, a one percent increase in the wife's education increases her self-employment participation by three percent.

The propensity of self-employment participation by husband or wife was a concave function of the duration of stay. On average men who have stayed at the migrant place of destination for about 14 years have a higher probability of getting self-employed than recent arrivals. It took women on average 12 years to enter into self-employment. Other things being equal, longer duration of stay allows rural migrant farm households to accumulate enough cash necessary to start small-scale self-employment enterprises. Non-labour incomes of husbands and wives are inversely related to the self-employment participation thus agreeing with the findings by Abdulai and Delgado (1999) that non-labour income tends to lessen the likelihood of self-employment participation in farm households. Migrant husbands from share-cropping households tend to engage less in self-employment activities suggesting that sharecropping households which are often associated with liquidity problems find it difficult to enter into self-employment jobs. Sharecropping contracts however did not influence the wife's probability of getting self-employed.

Table 6.5. Probit Estimates of Self-Employment Participation of Wives and Husbands

	Wives			Husbands		
Variable	Coeffi-cients	Marginal effects	t-ratio	Coeffi-cients	Marginal effects	t-ratio
Constant	-5.9993		-2.55***	0.7009		0.54
Age	0.2613	0.1026	2.07**	-0.0756	-0.0196	-1.40
(Age) ^{2}/100	-0.3289	-0.1291	-1.91*	0.0552	0.0143	1.03
Education	0.0871	0.0342	2.18**	0.0194	0.0050	0.68
Duration of stay	0.1362	0.0535	2.24**	0.0981	0.0254	1.78*
(Duration of stay)^2	-0.0028	-0.0011	-1.68*	-0.0031	-0.0008	-1.76*
Land	-0.0216	-0.0085	-0.62	0.0312	0.0081	1.01
Non-labour income	-0.7508	-0.2947	-2.25**	-0.5616	-0.1453	-1.65*
Sharecroppers	0.4112	0.1614	1.43	-0.6411	-0.1563	-2.32**
Household size	-0.0560	-0.0219	-1.38	0.0227	0.0059	0.75
Twimea-Nkwanta	3.0388	0.7624	4.48***	1.2038	0.3925	3.17***
Aworopata	1.3318	0.4656	2.60***	0.0712	0.0189	0.16
Woraso	0.3399	0.1346	0.88	-0.2994	-0.0699	-0.69
Ayerede	0.2582	0.1018	0.64	0.2672	0.0727	0.70
Log-likelihood			-62.55			-79.37
LR chi2 (13)			72.28			44.28
No. of observations			144			181

Note: * Significant at 10%; ** significant at 5%; *** significant at 1%.
Source: Author's Compilation from NWO Survey (2003).

Table 6.6 contains the probit estimates for wage employment participation of wives and husbands. Age had the anticipated positive sign in the employment participation equation of husbands and wives. The empirical results also indicate higher wage employment participation by younger husbands. However at the mean age of about 46 years, they start reducing their wage employment participation. As expected, the impact of land on wage employment participation by men was negative and significant, lending support to the hypothesis that migrant tenants with less cultivated land tend to prefer wage contracts as a secondary source of income by working in other people's farms as casual farm labourers. In contrast to self-employment participation, the probability of wage employment participation by husbands from sharecropping households appears to be high. Surprisingly, household size did not have any significant impact on self-employment and wage employment participation of wives and husbands in the sampled farm households.

Table 6.6. Probit Estimates of Wage Employment Participation of Wives and Husbands

	Wives			Husbands		
Variable	Coeffi-cients	Marginal effects	t-ratio	Coeffi-cients	Marginal effects	t-ratio
Constant	-1.9134		-0.93	-3.4832		-2.60***
Age	0.0156	0.0023	0.13	0.1302	0.0481	2.24 **
(Age) ^{2}/100	-0.0301	-0.0045	-0.18	-0.1479	-0.0546	-2.24 **
Education	-0.0114	-0.0017	-0.22	-0.0166	0.0087	0.82
Duration of stay	0.0531	0.0079	0.56	0.0235	-0.0061	-0.52
(Duration of stay)^2	-0.0032	-0.0005	-0.94	0.0004	0.0002	0.55
Land	0.0095	0.0014	0.23	-0.0873	-0.0323	-2.53 **
Non-labour income	0.0319	0.0048	0.16	-0.0026	-0.0009	-0.01
Sharecroppers	0.0019	0.0003	0.01	0.6546	0.2434	2.63 ***
Household size	-0.0252	-0.0038	-0.61	-0.0046	-0.0017	-0.16
Twimea-Nkwanta	0.3617	0.0115	0.11	0.6147	0.2364	1.74 *
Aworopata	0.0739	0.3123	2.64***	1.9661	0.6377	4.39 ***
Woraso	0.3617	0.0638	0.62	0.2586	0.0983	0.67
Ayerede	1.3826	0.2941	2.64***	1.6542	0.5914	4.71 ***
Log-likelihood			-46.19			-88.39
LR chi2 (13)			19.95			63.82
No. of observations			144			181

Note: * Significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's Compilation from NWO Survey (2003).

Having explained the empirical results on the determinants of off-farm work participation, we now proceed to discuss the estimation results on the hourly returns functions and wage offer functions for wives and husbands. With the inclusion of the IMR, the OLS estimates of the hourly returns and wage determination functions are now free from selection bias. The estimates for the self-employment hourly return equation are reported in Table 6.7 and the estimation results on the wage offer functions for husbands and wives are contained in Table 6.8. Descriptive statistics are provided in Annex 6.1. The dependent variables are observed hourly returns for self-employment and observed wage employment wages for husbands and wives. The IMR was significant in the self-employment hourly return function for husbands and wives. This emphasises the importance of controlling for sample selection bias of non-participating husbands and wives. The selection effect however was more important for self-employment than for wage employment. To control for possible heteroskedascity induced by the 2-step estimation approach, robust standard errors are reported. Only the education variable for wage employed wives had the anticipated positive sign and it was not even significant at 10 percent. Education however leads to lower self-employment wages for husbands and wives. Moreover, wage-employment wage for wives decreased with age but for husbands, it increased with age. In particular, a 1 percent increase in the husband's age increases his wage-

employment wage by 9 percent but leads to an increase of 8 percent in the wife's wage employment wage.

Table 6.7. Estimation Results of Hourly Return Functions for Self-Employed Wives and Husbands

	Wives		Husbands	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Constant	7.8726	2.84***	6.8787	4.47***
Age	-0.1029	-0.60	0.0208	0.36
$(Age)^2/100$	0.1287	0.54	0.0062	0.12
Education	-0.0715	-2.11**	-0.0553	-2.26**
Aworopata	-1.5235	-4.40***	1.4523	4.58***
Woraso	0.9523	1.77*	-0.0279	-0.11
Ayerede	1.1288	2.44***	0.8266	1.92*
Inverse Mills ratio (λ)	2.8767	4.37***	2.1443	3.20***
R^2	0.3791		0.2522	
Wu-Hausman	7.19		8.99	
Number of observations	63		45	

Note: * Significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's Compilation from NWO Survey (2003).

Table 6.8. Estimation Results on Wage Offer Functions for Wage Employed Wives and Husbands

	Wives		Husbands	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Constant	11.0767	11.30***	7.5436	7.02***
Age	-0.0827	-1.65*	0.0871	1.86*
$(Age)^2/100$	0.0912	1.52	-0.1071	-2.16**
Education	0.0167	0.67	-0.0113	-0.81
Aworopata	-0.0219	-0.09	1.0106	2.39**
Woraso	-0.1939	-0.25	0.8342	2.41**
Ayerede	-0.2896	-2.14**	0.3525	1.23
Inverse Mills ratio (λ)	-0.1869	-0.45	-0.8202	-1.20
R^2	0.3083		0.2079	
Wu-Hausman	13.50		4.36	
Number of observations	19		69	

Note: * Significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's Compilation from NWO Survey (2003).

The empirical results also suggest lower hourly self-employed returns for migrant wives in Aworopata but higher returns for those in Woraso and Ayerede. In contrast to self-employed wives in Aworopata, hourly self-employment returns were higher for husbands. Similar to wives, husbands in Ayerede also receive higher wages. Moreover in Aworopata and Woraso, wage-employment wages of husbands appear to be high but lower for wives in Ayerede. The difference in returns to labour implies the labour markets for self-employment and wage employment are very sensitive to locational characteristics such as availability of employment opportunities, trading opportunities and distance from the villages to towns etc.

6.2.2. The Choice Between On-Farm and Off-Farm Work

Farm households have a choice between on-farm and off-farm work (Lopez, 1984). This choice has most often been attributed to returns to labour from the two activities. For instance, implicit wages from off-farm work may be lower than the value of marginal productivity on the farm due to transport costs, monitoring costs, etc. Hence these costs, together with lack of market opportunities embodied in low alternative wages may persuade farmers to work on their farms beyond the point where the marginal product of labour equals the hired labour wage rate. Also if labour market exists, the household may choose to work on the farm only to the point where the marginal rate of substitution of leisure for farm income is equal to the wage rate. If this point is below the economic optimum level of farm labour use, the household would hire additional labour. On the other hand, if this point is above the economic optimum level of farm labour use, members of the farm household would allocate their time off the farm. Other things being equal, a rise in wages would induce a reduction in the desire to hire-in labour (Upton, 1996). However if wages are high enough, members of the farm household may be persuaded to seek off-farm work.

Apart from the implicit wage differences, the households may choose to allocate part of their time endowments based on other factors prevailing in the local economy. When farm households depend on seasonal agricultural production and especially in periods when agricultural productivity is very low, part-time job in the off-farm sector is vital in generating additional income. Other reasons may be that the labour market is poorly developed with no rural credit market for farming and also that risks in farming are high to compensate the farmer for his labour time on the farm. High levels of family labour supply may also induce the farm households to direct extra labour endowments off-the farm instead of on the farm (Benjamin, 1992). Moreover, less productive farm households may have stronger inclination to join the off-farm job market than more productive households.

6.3. Labour Supply Functions

The analyses on the income generation strategy of the farm households so far have shown that they allocated their time endowments to both on-farm and off-farm work. Having examined the determinants of off-farm work participation in Section 6.2, the next task is to focus on the extent of their on-farm or off-farm work participation. This Section is devoted to this analysis. In an attempt to investigate the labour supply response of peasant households, most studies in the literature have alluded to the separability (e.g. Barnum and Squire, 1979; Rosenzweig, 1980; Arayama, 1986; Benjamin, 1992) and non-separability (Gronau, 1977; Lopez, 1984; Deolalikar and Vijverberg, 1987; Jacoby, 1993; Skoufias, 1994a; Abdulai and Delgado, 1999) between production and consumption decisions of farm households.

Separation models assume that if the labour market is efficient and functioning, market prices support a separation of household consumption and production decisions. Under separability, the market wage provides an exogenous measure of the value of time of family labour, irrespective of whether the farm households work on-farm or off-farm. The implications of separation are that household preferences do not influence the amount of labour time on the farm. Also separation models do not restrict a mixture of family and hired labour use on the farm. Benjamin (1992) in particular, tested the separation hypothesis among rice farmers of rural Java in Indonesia. The non-separation models contend that labour market imperfection, leads to hiring-in of labour, off-farm employment constraints and differing efficiencies of family and hired labour. In that case, it is the shadow wage and shadow profits which determine the labour supply of peasant households (see for instance Jacoby, 1993). [13] The difficulty with identifying household preferences in non-separation model is that the implicit wage can never be observed but it could be computed only after estimation of production of the farm.

6.3.1. Theoretical Model

The underlying theoretical model on the time allocation of the households is that they differ in their endowments (household characteristics and farm characteristics, etc.) which determine how much can actually be done within the households. In terms of hours of work, there must be some mechanism that makes hours of work more strenuous or less strenuous or that more time is available so that the marginal utility of leisure for all persons (discounted by the marginal value of income) is equal to the wage. The household then maximises utility of income and leisure as:

[13] Skoufias (1994a) outlines three useful steps for estimating the labour supply functions with shadow wages instead of observed wages.

$$\underset{L^*}{Max}\ U = U(Y, L) \tag{6.8}$$

where Y is the household's total income, and L is leisure.

Let the total time endowment of the household be:

$$T = L_1 + L_2 + L_3 + L \tag{6.9}$$

where T is the total time endowment, L_1 is the time allocation to on-farm work which generates profit Π; L_2 and L_3 represent the time allocations to different activities off the farm.

Rearranging (6.9), the household's leisure time becomes:

$$L = T - L_1 - L_2 - L_3 \tag{6.10}$$

If w_1, w_2 and w_3 are returns to labour from these employment activities and $\overline{Y}$ is some unearned income, then the total income of the household can be expressed as:

$$Y = w_1 L_1 + w_2 L_2 + w_3 L_3 + \Pi + \overline{Y} \tag{6.11}$$

Substituting (6.10) and (6.11) into (6.8) gives the household's utility maximisation problem as:

$$\underset{L^*}{Max}\ U = U(w_1 L_1 + w_2 L_2 + w_3 L_3 + \Pi + \overline{Y},\ T - L_1 - L_2 - L_3) \tag{6.12}$$

The first order conditions for utility maximum then becomes:

$$\partial U/\partial L_i = w_i\, \partial U/\partial Y - \partial U/\partial L = 0 \tag{6.13}$$

Rearranging (6.13) gives the returns to labour from the different employment activities as:

$$w_i = (\partial U/\partial L)/(\partial U/\partial Y) \text{ for all } w_i . \tag{6.14}$$

But the returns w_i are not the same for all activities $i = 1,...,3$, since there is a translation of hours into income. Instead of $Y_i = \sum w_i L_i$, we may think of the household's total income Y_i as a function of L_i involving w_i but also depending on other household and farm characteristics such as sharecropping etc that affect the overall income of the farm household. Similarly one hour of work on-farm may not detract as much from leisure as one hour of off-farm work. So a more elaborate model could be:

$$\underset{L^*}{Max}\ U = U\left(\begin{array}{c} f^1(w_1L_1, z) + f^2(w_2L_2, z) + f^3(w_3L_3, z) \\ + \Pi + \overline{Y}; T - \sum g^i(L_i, z) \end{array}\right) \tag{6.15}$$

where the *f's* are functions explaining earnings from the different employment; activities and other household and farm characteristics; and *g* is a function representing the time allocations to the different activities.

The first order derivatives then become:

$$\partial U/\partial L_i = (\partial U/\partial Y)\cdot(\partial f^i/\partial L_i) - (\partial U/\partial L)\cdot(\partial g^i/\partial L_i) = 0 \tag{6.16}$$

where L_i is the labour supply to different activities, and $(\partial U/\partial L)/(\partial U/\partial Y)$ is the same for all *i*, but also by specific elements included in f^i and g^i. Hence solving the utility maximisation, the structural labour supply function can be represented in a reduced form as:

$$L^{j*} = L(w_1^j, w_2^j, w_3^j; z) \qquad j = M,\ F \tag{6.17}$$

where *j=M* for husbands and *j=F* for wives; w_1 is the return to labour from on-farm work; w_2 and w_3 are returns to labour from off-farm activities such as wage employment and self-employment; *z* is a vector of household and farm characteristics which affects supply of labour in the household.

6.3.2. Estimation of Labour Supply Functions

The theoretical model in the previous Section has shown that the labour supply response of the farm households depends on the returns to labour from on-farm and off-farm work, and other household and farm characteristics. Now, for the sampled farm households, the labour market for hired labour appears to be functioning since we have actual data on hired farm labour in addition to family labour use in both on-farm and off-farm work. One could therefore infer that wage rates to hired farm labour might be the market determined prices or the implicit wages received by the farm households. Hired farm labour wages and the market wages therefore provide an exogenous measure of the value of time of family labour, irrespective of whether the farm households work on-farm or off-farm. This estimation procedure then departs from the shadow wage approach.[14]

[14] Preliminary empirical estimation of the labour supply functions with the shadow wage approach proposed by Jacoby (1993), Skoufias (1994a) and others did not produce the desired empirical results consistent with the theoretical underpinnings of the labour supply response of farm households.

In this Section, on-farm labour supply and labour supply to self-employment and wage employment activities of husbands and wives are estimated. The dependent variables are hours of on-farm work, and hours of self-employment and wage employment activities. The dependent variables display a number of zero observations and one way of dealing with the zero censoring in the dependent variables in the estimation is to employ the Tobit model (Rosenzweig, 1980; Khandker, 1988). However, the standard Tobit model imposes some restrictions and produces biased estimates if variables that determine the employment participation decision of the farm household appear to differ from those determining their labour supply response (Skoufias, 1994b). Moreover, the predicted self-employment hourly return and wage-employment wage are endogenous and need to be corrected to avoid simultaneity bias. The generalised Tobit estimator or the two-step instrumental variable (IV) technique (Heckman, 1980; Amemiya, 1984; Skoufias, 1994b) is therefore employed in the estimation of the labour supply functions (similar approach was used in Section 4.6 of Chapter 4). The endogeneity of wage employment wages and self-employment hourly returns for husbands and wives were accounted for in the first step based on the wage predicting equations which employed age, education, duration of stay, non-labour income etc. as exogenous variables in a probit model. In the second step which deals with the extent of off-farm work participation over the whole sample, we employ a 2-sided Tobit model (Maddala, 1983).

6.3.3. Empirical Results of the Labour Supply Functions

Table 6.9 provides the Tobit estimation results on labour supply to on-farm work by husbands and wives. The farm wage variable exhibits an upward sloping labour supply for husbands but it was not significant even at 10 percent in the labour supply function for wives. There is also a direct relationship between the husband's self-employment hourly returns and the wife's on-farm labour supply. The wife's on-farm labour supply is therefore sensitive to the husband's off-farm returns. What these empirical results also indicate is that wives increase their labour time on the farm if the hourly returns of their husbands from self-employment increase. Wives in the farm household normally undertake supervision on hired farm labour so the intuition here is that if self-employed husbands finance farm activities with returns from self-employment by employing more casual labour on the farm, then the on-farm labour hours of wives as supervisors would increase *ceteris paribus*. Moreover, the empirical result is consistent with the family utility maximisation problem which posits that in a household, the husband's time allocation decisions cannot be taken as independent from that of the wife. The empirical results therefore show that any study that ignores this interrelationship between the husband and wife's decision may result in specification error. The age and education variables did not produce any significant results in the on-farm labour supply of the households. The labour supply of labour by husbands and wives also increased significantly in larger households, a result which confirms Benjamin's (1992) assertion that when family size increases, the labour power of farm households is raised more than the demand for leisure time.

Table 6.9.Tobit Estimates of On-Farm Labour Supply Functions of Wives and Husbands

Variable	On-farm Hours			
	Wives		Husbands	
	Coeffi-cient	t-ratio	Coeffi-cient	t-ratio
Constant	1.2252	0.70	-2.9366	-2.22**
Farm wage	0.0544	1.56	0.2370	2.46**
Wife's wage-employment wage (est'd) †	-0.0634	-1.46	-0.0097	-1.20
Wife's self-employment hourly return (est'd)†	0.0018	0.05	0.0252	1.01
Husband's wage-employment wage (est'd) †	-0.0041	-0.31	0.0106	0.40
Husband's self-employment hourly return (est'd)†	0.0211	1.98*	-0.0106	-0.66
Age	-0.0629	-1.18	-0.0083	-0.36
$(Age)^2/100$	0.0677	1.04	0.0135	0.53
Education	0.0115	0.81	-0.0155	-1.42
Household size	0.0321	3.12***	0.0549	5.38***
Twimea-Nkwanta	-0.0886	-0.40	0.4917	1.68*
Aworopata	0.1099	0.52	1.6324	2.87***
Woraso	-0.2671	-1.60	-1.0328	-2.41**
Dromankese	0.0253	0.16	-0.0149	-0.09
Log-likelihood	-85.81		-135.86	
LR chi 2 (13)	55.85		77.57	
Number of Observations	144		181	

Note: *** Significant at 1%, ** significant at 5%,* significant at 10%.
† Shows variables instrumented in the labour supply function.
Source: Author's Compilation from NWO Survey (2003).

Table 6.10 shows the Tobit estimates of off-farm labour supply of husbands and wives. The farm wage variable was directly related to wage employment hours. Since the farm wage represents the village-level wage rate to hired farm labour, the empirical results imply that husbands increase their labour time on other people's farms when the wage rate to hired farm labour increases. The significant negative own-wage effects of wives and husbands suggest backward bending labour supply to wage employment. The significant positive hourly self-employment returns of wives and husbands also suggest an upward sloping labour supply to self-employment jobs. These empirical results indicate that higher self-employment returns lead to substitution effects that are greater than the opposing income effects, thus agreeing with the utility maximisation hypothesis.

Table 6.10. Tobit Estimates of Off-Farm Labour Supply of Husbands and Wives

	Wage employment hours		Self-employment hours	
Variable	Wives	husbands	wives	husbands
Constant	7.0015**	-5.1288 ***	-1.7999	0.4656
	(1.94)	(4.92)	(-1.29)	(0.28)
Farm wage	0.0325	0.3407 ***	-0.0173	-0.0299
	(0.56)	(4.64)	(-0.68)	(-0.24)
Wife's wage-employment wage (est'd)†	-0.2596**	-0.0016	0.0389	-0.0078
	(-2.36)	(-0.32)	(1.44)	(-0.87)
Wife's self-employment hourly return	-0.1395	0.0122	0.0952***	0.0299
(est'd)†	(-1.57)	(0.75)	(3.80)	(1.15)
Husband's wage-employment wage(est'd)†	0.0165	-0.0347 *	0.0009	0.0087
	(0.64)	(1.81)	(0.09)	(0.27)
Husband's self-employment hourly return	-0.0028	-0.0107	-0.0016	0.0394**
(est'd)†	(-0.15)	(1.07)	(-0.20)	(2.11)
Age	-0.2488**	0.4521 ***	0.0680	-0.0235
	(-2.12)	(2.66)	(1.51)	(0.92)
$(Age)^2/100$	0.2810**	-0.0519 ***	-0.0791	0.0085
	(2.10)	(-2.66)	(-1.43)	(0.30)
Education	0.0426	-0.0091	0.0140	0.0158
	(1.31)	(-1.35)	(1.36)	(1.37)
Household size	-0.0329	-0.0017	-0.0047	-0.0009
	(-1.52)	(-0.26)	(-0.63)	(-0.08)
Twimea-Nkwanta	1.0326*	0.7146 ***	-0.0238	0.2913
	(1.77)	(3.14)	(-0.16)	(0.79)
Aworopata	0.4122	0.2409	2.0266***	-0.5724
	(0.99)	(1.52)	(4.67)	(-0.78)
Woraso	-0.1263	-0.0404	-0.6235**	0.0791
	(-0.39)	(1.52)	(-2.07)	(0.15)
Dromankese	0.3979	0.1204	0.2129*	0.3565*
	(1.00)	(1.05)	(1.72)	(1.80)
Log-likelihood	-40.31	-50.08	-45.16	-74.37
LR chi 2 (13)	18.28	61.59	63.17	47.17
Number of observations	144	181	144	181

Note: *** Significant at 1%, ** significant at 5%,* significant at 10%. Figures in parentheses are t-ratios.

† Shows variables instrumented in the labour supply function.

Source: Author's Compilation from NWO Survey (2003).

The empirical results on age also indicate that wage employment hours decrease with the wife's age while it increases with husband's age. The impact of the wife's age on wage employment hours agrees with a study by Rosenzweig (1980) with Indian data but contrasts with studies by Abdulai and Delgado (1999) on rural farm households in Northern Ghana, and Abdulai and Regmi (2000) for Nepal. The influence of the husband's age on wage employment hours however agrees with the studies by Abdulai and Delgado's (ibid), and Abdulai and Regmi (ibid). Consistent with

Abdulai and Regmi's (ibid) study with Nepal data, the years of formal education did not influence off-farm labour supply response of husbands and wives.

6.4. Summary and Conclusions

This Chapter has analysed off-farm income generation of Upper East migrant farm households in Brong Ahafo. The market participation by husbands was 61 percent and 42 percent for wives. The main sources of off-farm earnings for the households were wage employment and self-employment activities. The mean earnings from off-farm work was ¢2,840,976 (US$422). Of the total off-farm earnings, 70 percent constitute self-employment income whereas agricultural and non-agricultural wage employment comprise of 9 percent and 21 percent respectively.

The participation decisions, wage determination equations and self-employment return functions of husbands and wives were investigated. Self-employment participation by wives decreases as age increases. Wives increase their self-employment participation by a margin of about 0.34 when their education is increased by 1 percent. The influence of the length of stay on self-employment participation by men and women is significantly positive, an empirical result which has not been investigated in most empirical studies. Migrant husbands from sharecropping households tend to engage less in self-employment activities but increase their wage employment participation suggesting that sharecropping households which more often than not have liquidity problems find it difficult to enter into self-employment jobs but increase their wage employment participation in order to solve the cash flow problems of the household. However the probability of migrant wives getting self-employed was not influenced by whether or not their husbands had plots under sharecropping contracts. This result is also not surprising as in most households, the start-up capital for wives in self-employment was given by the husbands. These empirical findings are unique in a sense that previous empirical studies have not paid much attention to the importance of tenure differences on the household's leisure. Wage employment participation by men increase at the younger age but decrease during old age. The impact of land on wage employment participation lends support to the hypothesis that migrant tenants with less cultivated land tend to prefer wage contracts by working as casual farm labourers in other people's farms. The age variable which proxied for experience of an individual in the household concurs with the human capital theory. In particular, a one percent increase in the husband's age increases his wage employment wage by nine percent.

Given that the farm households had a choice between on-farm and off-farm work, the labour supply response of husbands and wives were examined. To capture the effects of a spouse's labour supply response on the other, we introduced each others employment wage or hourly returns as separate regressor in the labour supply function of each other, an approach which departs from previous empirical studies and also ensured robust estimation, The farm wage variable exhibits an upward

sloping labour supply for husbands. Moreover, the wife's on-farm labour supply is sensitive to the husband's hourly returns from self-employment. The time allocations of husbands and wives increase on-farm when family size increases. The farm wage variable is directly related to the wage employment hours of husbands indicating that men increase their labour time in other people's farm as casual labourers when wage rates to hired farm labour increase. Whilst own wage effects of couples indicate a backward bending labour supply, the effects of hourly self-employment returns of couples suggest an upward sloping labour supply function.

Annex 6.1.

Descriptive Statistics of Variables Used in the Participation, Wage Offer and Labour Supply Functions

	Husbands (N=181)		Wives (N=144)	
Variable	Mean	Std. Deviation	Mean	Std. Deviation
Land (acres)	5.7	4.07	5.8	3.93
Non-labour income †	0.58	0.66	0.58	3.93
Family labour hours	604.4	607.57	369.1	502.75
Self-employment hours	90.9	172.29	129	175.28
Wage employment hours	63.8	162.15	27.6	127.39
Age (years)	45.9	13.34	34.8	8.95
Duration of stay (years)	13.8	10.26	11.8	8.51
Education (years)	2.03	3.98	1.4	3.86
Household size	9.9	4.64	10.6	4.34
Children of farmer (< 15 years)	2.4	1.70	2.6	1.67
Children of farmer (> 15 years)	0.9	1.39	1.0	1.47
Sharecropping dummy	0.40	0.49	0.39	0.49
Livestock dummy	0.95	0.22	0.96	0.18
Twimea-Nkwanta dummy	0.19	0.40	0.18	0.39
Nkwaeso dummy	0.15	0.36	0.15	0.36
Aworopata dummy	0.09	0.30	0.08	0.27
Woraso dummy	0.15	0.36	0.18	0.39
Ayerede dummy	0.29	0.45	0.31	0.47
Dromankese dummy	0.11	0.31	0.08	0.27

Note: † Values of incomes are in millions Ghanaian Cedis (¢); Exchange Rate: US $1= ¢8500 in 2003.

Source: Author's Compilation from NWO Survey (2003).

Chapter 7

Migrant Remittances

Related to off-farm income generation of migrant farm households are the remittances they sent back home to relatives. Indeed, the economic impact of rural migration is reflected through remittance income to the home area. Migrant rural households remit to families mainly for food purchases, education of children and other relatives left behind. The long-term strategy for improving the living standards among the origin households of the out-migrants is to use the remittances for investment in the family farm, purchasing of livestock and investment in buildings, for instance. The aim of this Chapter is to explore the remittance decisions of the migrant households. The ability of the migrant farm households to remit is linked to how much they earn from food crop production and off-farm employments. A typical migrant farm household in Ghana is part of an extended rural family. In particular, remittance motives based on family ties, obligations and informal agreements were prevalent among the destination households. The bond and ties are quantified in terms of the frequency and volume of remittances. Although these kinship ties, bond, and informal agreements may place enormous responsibilities on out-migrants to remit, one feature of the rural-rural remittances is that flows are not uni-directional. The mutual-supporting roles between the origin and destination households were quite significant in that about 39 percent of the out-migrant households received in-kind remittances from the wife's family and 41 percent received similar remittances from the husband's family in the home area.

Having established that household earnings, and human capital investment variables such as education of couples, and other home linkage variables like informal agreement and inheritance claims influence the decision of the migrant farm households to remit, the effects of these determinants are quantified empirically. Investigating the remittance decisions permits better understanding of why remittances matter in household strategies beyond constituting an additional source of income for the origin households. To obtain robust empirical estimates for the remittance functions, a 2-step instrumental variable (IV) Tobit approach is employed. The Tobit model takes care of both remitting and non-remitting households whilst the instrumental variable (IV) technique corrects the simultaneity bias in the right hand side endogenous variables like earnings and livestock wealth.

The Chapter is organised as follows. Section 1 provides a comprehensive review of the literature on the determinants of migrant remittances. Section 2 discusses the linkages of the destination migrants to the home area with evidence from the farm household data. Section 3 explores the volume of remittance flow between the destination and origin households. In Section 4, the effects of the determinants of remittances from the destination households to either the husband's or the wife's

family in the home area are quantified with the 2-step IV Tobit model and simulations. Section 5 concludes the Chapter.

7.1. Motives for Remittances: Review of Literature

Remittances are an important source of income for families of out-migrants and remittance money is noted as one of the institutionalised features of migration in Africa. In the literature, a household decision to send remittances to the home area has been attributed to altruistic behaviour of migrants (Lucas and Stark, 1985; Cox *et al.*, 1998); motives based on norms, strengthening of family ties and bonds (Banerjee, 1981; Becker, 1988; Adeku, 1995); insurance arrangements and social security (De la Brière *et al.*, 1997; Schrieder and Knerr, 2000; Gubert, 2002; Mazzucato, 2006); achieving the goals of risk diversification (Stark and Levhari, 1982; Grimard, 1997); investment and inheritance (Bernheim *et al.*, 1985; Cox, 1987; Hoddinott, 1994; Subramanian, 1994), and the human capital investment hypothesis (Abbas and Infant, 1986). Other motives include sending remittances to meet expenditures for local income generation (Taylor and Wyatt, 1996), and remittance meant to shift consumption preferences away from local exploitation of the environment through increases in the standards of living (Bertram, 1986; Connell, 1994; Connell and Conway, 2000). The Sections which follow provide a comprehensive literature review on the motives for remittances.

(i) Altruistic Motives for Remittances

Lucas and Stark (1985) and Cox *et al.* (1998) have noted that migrants remit because of pure altruism, pure self-interest and tempered altruism or enlightened self-interest. Pure-altruistic migrants are those who remit because they are concerned about the welfare of family members left in the home area. Remittances from pure altruistic migrants are expected to increase when earnings rise (Banerjee, 1981). These altruistic decisions are modelled by allowing the migrants to derive utility from the consumption level of recipients left in the home area

Purely self-interest remitting households are motivated by expected inheritance (bequest), proper management of investment in valuable assets such as cattle, land, houses, etc. in the home area and also intentions to return home after long spells outside. For example, empirical evidence provided by Lucas and Stark (1985) from Botswana indicate that sons who migrated from households with more cattle are those who remitted regularly. The implication of this outcome is that the sons who are the the traditional heirs remit to families with larger herds, but this relationship is moderately negative for non inheriting family members (e.g. daughters). In Kenya, Hoddinott (1994) finds that remittance flows are guided by the prospects of land inheritance. However, with recent micro-data from Cameroon, Schrieder and Knerr (2000) also find that migration with remittance strategies fails as social mechanism when potential remitters do not expect any sizable inheritance.

Remittances based on tempered altruism or enlightened self-interest is viewed as part of intertemporal, mutually beneficial contractual arrangements between the migrant and the family (Lucas and Stark, 1985). Most rural households consider having their members elsewhere as a Pareto-superior strategy. However, Hayashi *et al*. (1996) and Altonji *et al*. (1998) have pointed out that "motives" in remitting as used in the literature must be distinguished from the roles of altruism and the trade in exchange of service with the parent.

(ii) Norms, Family Ties and Bonds

Remittance decisions of out-migrants could be motivated by the existence of social norms, solidarity, obligations or one's loyalty to his family lineage (Becker, 1988). In the Ghanaian traditional system for example, most migrants remit to their families because of moral duty to do so (Adeku, 1995). The degree of family cohesion is an important element of the social structure in Africa and the strength of family links are assessed in terms of visits and remittances to the home area (Banerjee, 1981). Lipton (1980) has also noted that migrants who consider remittances as social obligation retain all political and social roles in the home area by remitting bulk of their income to assist in socio-economic development. Stark (1991) also argues that young out-migrants from rural areas are susceptible in terms of support obligations to families in the home area, especially if they do not intend to return to their native villages, or they do not expect any sizeable inheritance. Related to the socio-cultural obligations to send remittances is the aspiration of bequests which was noted by Lucas and Stark (1985), and by Hoddinott (1994). If expected inheritance serves as incentive to remit, then those who need them most are less likely to receive them, given these families have migrant members.

(iii) Insurance and Social Security

Another important motivation to remit in the literature is remittance money being used as insurance. Underlying this assumption is that remittances are part of an insurance contract between the out-migrant and his family, and that remittances are sent to secure and smooth the recipient's food consumption level in a context of missing or imperfect financial and insurance markets. In their study on Dominican Republic migrants, De la Brière *et al.* (1997) relate remittances to the size of the recipient's income shock, which is proxied by the total number of working days lost in the year because of illness. They found that insurance is a strong reason to remit and that male migrants only fulfil this insurance function when they are the sole migrant in their family.

An empirical study by Gubert (2002) on Malian rural migrants also brings some support for the view that insurance is an important motivation for remittances. Using household-level data on Ghanaian migrants living in the Netherlands, Mazzucato (2006) shows that informal insurance arrangements work between overseas migrants and their network of friends, family and business partners back home. In contrast to what pertains in the empirical literature where the focus has been on consumption outcomes, her study analyses the institutional arrangements that make such systems

possible especially where there is no geographic proximity to ensure effective monitoring and enforcements among senders and those who receive them.

(iv) Risk Diversification Hypothesis

The decision to remit also depends on the household's desire to achieve the goals of portfolio diversification (Stark and Levhari, 1982). For instance, the literature suggests that Ivorian households engage in risk-sharing arrangements with other members of their kinship group (Grimard, 1997). Here, it is presumed that household members, who for economic and non-economic reasons migrate to other villages and cities, form a complex risk-sharing group of a given large extended family. However, Grimard (1997) argues that regardless of theoretical and empirical considerations, it is possible that a complete risk-sharing framework does not represent the reality in Côte d'Ivoire.

The hypothesis of risk diversification also predicts remittances to be higher in households most exposed to local income risks and/or in periods when risk is most acute. The empirical work in Botswana by Lucas and Stark (1985) and Stark and Lucas (1988) support this view that families who are at risk of losing cattle or who rely mainly on crops for their subsistence are the ones who receive more remittances during times of drought. Evidence provided by Rosenzweig and Stark (1989) also suggests that informal risk-sharing schemes exist and perform relatively well in geographical locations with ethnic ties and where group members know each other well. In that case, monitoring and enforcement costs are considerably reduced. Using panel data on Indian rural households, Rosenzweig (1988) also relates remittances to the size of parents' income shock and evidences some risk sharing, although remittances only compensate for a small fraction of the income loss.

(v) Investment and Inheritance Motivation

The decision to remit by a particular migrant is also viewed as a contribution to the investment in household assets later to be inherited. This hypothesis is based on models found in the literature related to inter vivos transfers and bequests in developed (Bernheim *et al.*, 1985; Cox, 1987) and developing (Hoddinott, 1994; Subramanian, 1994) economies. The underlying framework however depends on the assumed relationship between parents and children. The literature on the strategic bequest motives (Bernheim *et al.*, 1985; Perozek, 1998) focus on the parents' behaviour in holding the bequests and allocating it according to the children's relative attentions. In Hoddinott (1994), the focus is on the migrant who takes as given the parent's "reward" function and sends remittances to maximize his utility function.

Out-migrants may also invest for the future either out of concern for inheritance or as a way of maintaining status and returning home with social capital (Lucas and Stark, 1985; Hoddinott, 1994; De La Cruz, 1995; Brown, 1997; Curran and Saguy, 2001). De la Brière *et al.* (2002) conclude from their study that, if a migrant sends remittances to invest in inheritance, he will send more remittances when the parents'

assets and income are higher if he is not too risk averse. He will also remit more if the probability of inheriting is higher, and if he is rich, and less risk averse.

(vi) Human Capital Investment Hypothesis
Apart from the inheritance, investments and insurance motives, there are other economic motives behind sending remittances to one's family. For instance, migrants may send remittances to reimburse families for some costs of education. Also an important human capital investment of remittances is education of children. Abbas and Infant (1986) has confirmed that children who enjoy uninterrupted schooling are children of out-migrants who received regular remittances towards their education. In a study done by Batzlen (1994) for Pakistan, he found out that children have been granted a better education for the purpose of earning off-farm income when grown up. These children then have moral obligation to support the sponsor of their education, eventually through remittances. Hedden-Dunkhorst (1993) for example finds from her study in Zimbabwe that investment in children's education from off-farm employment is regarded as a long-term strategy to secure the household's livelihood.

7.2. Motives for Remittances: Evidence from Farm Household Data

With the farm household survey data collected on Upper East migrant farm households in Brong Ahafo, this Section discusses some of the remittance motives found in the literature. In particular, we find remittance motives such as family ties and obligations, altruistic motives and remittances linked to life cycle effects and the human capital investment hypotheses. It should be noted that data were collected on destination households only. We do not have matching data on the origin households unlike e.g. Mazzucato, 2006. Notwithstanding the data limitations, and as the descriptive data later show, there is reason to believe that informal agreements and bequests-related transfers are prevalent within Upper East migrant farm households in Brong Ahafo.

7.2.1. Linkages of Out-Migrants to the Home Area

Rural migrants from Northern Ghana cling to land, kinship ties and lineage such that the out-migrant is faced with lifecycle obligations to the home area. The bond and ties are quantified in terms of the frequency and volume of remittances to and from the migrant household, and occasional visits. Migrants visit the home area because they may have left children, wives and other close relatives behind or to attend to other pressing social responsibilities such as funerals, traditional festivals and durbars. The two most important factors which link Upper East migrants to the home area are informal agreements they reached with relatives before they migrated and aspirations to inherit in the home area. The informal agreements include regular remittances, occasional visits, and an understanding or arrangement to permit other family members apart from wife or children to join the out-migrant once he is

established at the migrant place of destination. Such relatives may come and stay permanently with the out-migrant or others may visit or stay temporary as seasonal migrants.

In Northern Ghana sons are traditionally apparent heirs in their families in case the father dies. Apart from this, it is an accepted norm and tradition that only sons have the responsibility of taking care of their parents. It is also morally binding for husbands to feed, clothe, shelter and provide for the support and comfort of their wives and children especially when they are not living together. The negligence of these duties attracts the displeasure of both family and the community. These kinship ties, bond and roles and informal arrangements thus place enormous responsibilities on male out-migrants. The proportion of migrant farm households with these informal agreements was 88 percent (Table 7.1) with larger percentage of them located in Techiman than in Nkoranza. The most notable Upper East ethnic groups in Brong Ahafo with such informal arrangements are the Builsas, Busangas and Gurunshies.

7.1. Linkages of Migrants with Home Area

	Study Districts		
Linkages with home variable	Techiman (%)	Nkoranza (%)	All (%)
Informal agreements with relatives	94	80	88
Inheritance claim in the home area	88	56	76
Owned land before migrating	46	43	45

Source: Author's Compilation from NWO Survey (2003).

7.2. Relationship of Migrant with Home Area

	Informal agreement with relatives		
Claim to inheritance	Yes (%)	No (%)	All (%)
Yes	78	59	76
No	22	41	24
	Migrant still maintains ownership of land		
Owned land before migrating	Yes (%)	No (%)	All (%)
Yes	100	12	45
No		88	55

Source: Author's Compilation from NWO Survey (2003).

An enticement to inherit bequests like cattle, land or house also serves as bond of relationship between the out-migrant household and the home family. Those with possible claims to inheritance in the home area are 76 percent. Cattle for instance, is an important asset in Northern Ghana as one's wealth is measured by the number of cattle he possesses. The informal agreements among the households were also related to inheritance claims by the households. As Table 7.2 suggests, about 78 percent of the households that reached some understanding with relatives before migrating also have aspirations to inherit cattle, land or house or a combination of any of the bequests.

Table 7.3 provides detail distribution of possible bequests among the sampled farm households. Out of the 76 percent of the farm households with claims to possible bequests, 18 percent constitute claims to cattle and 41 percent claims to land. In Northern Ghana, family heads had the sole responsibility of allocating family land among other family members who wish to farm on the family land. Even when the head is an out-migrant he still has the exclusive right to such "ownership" or responsibility. This is clearly seen in Table 7.1 and Table 7.2 where all the out-migrants who claimed to "own" land still hold claim to the family land even in their absence. However they sometimes abrogate such responsibilities to the next of kin when they happen to migrate. This position is however temporary as it reverts back to

Table 7.3. Distribution of Inheritance Claims among Migrant Households

	Study Districts		
Type of inheritance clams	Techiman (%)	Nkoranza (%)	All (%)
Cattle	19	18	18
Land	48	30	41
House	6		4
Cattle & Land	13	8	11
Cattle & House	2		1
Land and House	1		1
No inheritance	12	44	24

Source: Author's Compilation from NWO Survey (2003).

the out-migrant when he returns home. With the exception of the Builsas, almost all the Upper East ethnic groups have aspirations to inherit land and cattle. However, only the Kusasis expect to inherit houses in the home area.

7.2.2. Reasons for Remittances

The net effect of rural remittances on the origin households and the rural economy is difficult to determine a priori with data on destination migrant farm households however as indicated in Table 7.4, various reasons have been offered by the destination households as to why they remit to their families in the home area. Notable among them are transfers meant purposely for food purchases, education,

and investments. The investment related remittances are meant for purchasing variable inputs, implements and labour for the family farm; purchasing livestock such as cattle, sheep and goats; putting up new houses for the out-migrant or renovating the family house in the home area, and finally cash transferred purposely to assist relatives or wives left in the home area to start some form of non-farm business enterprise to cushion them in times of income shocks. Remittances were also used for personal use, wedding, payment of hospital bills and donations towards funerals, development projects and so on in the home area.

Table 7.4. Reasons for Remittances to Relatives in the Home Area

Reasons for remittances	Techiman (%)	Nkoranza (%)	All (%)
1. Food Purchases			
Food	33	22	31
2. Education			
Children's education	5	4	5
3. Investments			
Family farm	10	4	9
Non-farm business	2	.	2
Livestock	15	4	13
Building	10	17	12
Family farm & livestock	1	.	1
Family farm & building	1	.	1
Livestock & building	1	.	1
Livestock & children's education	1	.	1
4. Miscellaneous Expenses			
Personal use	6	4	5
Wedding	2	.	2
Hospital bills	3	4	4
Donations	1	.	1
5. Food, Education, Investment, & Miscellaneous Expenses			
Family farm & food	1	.	1
Building & food	.	4	1
Children's education, livestock & food	5	9	5
Children's education & food	1	22	5
Family farm, food & personal use	.	4	1
Food & personal use	1	.	1

Source: Author's Compilation from NWO Survey (2003).

A significant proportion of the households in Techiman indeed instructed their relatives in the home area to invest the cash remittances in the family farms and valuable assets such as livestock, and buildings. The long-term strategy for reducing poverty among the rural households in the home area is to invest part of the remittances in the family farm as has been largely observed by Russell (1984) in Mozambique, Young (1987) in Sudan and Lucas (1987) in Botswana. Similarly, migrant farm households in Nkoranza remitted purposely for food and livestock purchases, and for payment of children's school fees. Investment in buildings in the home area was also a priority for Upper East migrant farm households in Nkoranza.

7.3 Remittance Flows

Large flows of remittances (both in-cash and in-kind) were observed within the migrant farm households. To assess these flows, we assumed remittances decision to be a joint decision by couples in the farm households.[15] Transfer payments were then sent to the husband's family as well as to the wife's family in the home area. The proportion of remitting households was about 86 percent (Table 7.5) and in all, 77 percent remitted to the husband's family while 51 percent remitted to the wife's family.

In-kind remittances such as food stuffs which are not predominantly grown at the migrant destination but serve as a staple food for Northern migrants such as millet, rice, and so on were also received by the destination households from relatives in the home area. Apart from cash, the in-kind remittances to origin households also include maize, yam, etc. The transfers of food to and from the destination households agree with the mutually supporting role hypothesis that remittances are sent to the origin

Table 7.5. Remittances from Destination Households

Variable	Techiman	Nkoranza	All
Proportion of households remitting (%)	90	81	86
To husband's family	76	78	77
To wife's family	67	28	51
To others not in the home area	46	10	31
Mean value of remittances sent (¢)	678,199	530,172	623,163
To husband's family in the home area	534,434	450,589	500,655
To wife's family in the home area	202,260	165,400	194,333
To others not in the home area	146,810	315,571	167,535

Note: Mean values are in Ghanaian Cedis (¢); Exchange rate: US$1= ¢8500 in 2003.

[15] In Chapter 5, it was observed that most couples farmed jointly on the same plots. Very few households had migrant wives with separate plots. The decision to work off-farm was also noted to be a joint decision by the couple where 'seed money' for small-scale self-employment enterprise undertaken by a wife for instance, is provided by the husband in most of the farm households.

family in times of crop failure and to the out-migrant during periods of consumption shortfalls. As depicted by Table 7.6, the mutual-supporting roles between the origin and destination households were quite significant in that about 39 percent of the out-migrant households received in-kind remittances from the wife's family and 41 percent received similar remittances from the husband's family in the home area. The values of annual remittances from the destination households to the home area however were skewed to the husband's family and so are the remittances received by the destination households from the home area. In Table 7.5 the mean annual remittance to the husband's family in the home area was ¢500,655 (US$59) while on average the annual remittances from the destination households to the wife's family was ¢194,333 (US$23). The skewed transfer payments to the husband's family in the home area were probably due to the imposed responsibility on sons (husbands) not daughters (wives) to look after other family members in most traditional settings in Northern Ghana. Similar to the amounts transferred to the origin families, the values of remittances received from the husbands family is approximately 3 times the amount received from the wife's family. Table 7.7 also shows that the net remittances to the husband's family were higher than the amounts remitted to the wife's family.

Table 7.6. Remittances to Destination Households

Variable	Techiman	Nkoranza	All
Proportion of households receiving remittances (%)	77	21	55
From husband's family	60	13	41
From wife's family	60	7	39
From others not in the home area	28	8	20
Mean value of remittances received (¢)	175,723	565,267	234,744
From husband's family	73,369	55,778	534,434
From wife's family	72,038	44,400	202,260
From others not in the home area	174,573	1,292,500	146,810

Note: Mean values are in Ghanaian Cedis (¢); Exchange rate: US$1= ¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

Table 7.7. Net Remittances from Destination Households

Variable	Techiman	Nkoranza	All
Households with net remittances (%)	92	81	87
From husband's family	82	78	80
From wife's family	73	28	55
From others not in the home area	52	15	38
Mean value of net remittances (¢)	517,028	383,983	468,189
To husband's family	444,820	441,625	443,586
To wife's family	125,131	154,300	130,965
To others not in the home area	36,900	-504,182	-50,628

Note: Mean values are in Ghanaian Cedis (¢); Exchange rate: US$1= ¢8500 in 2003.
Source: Author's Compilation from NWO Survey (2003).

In Table 7.8, we compare remittances to the couple's families for positive earning households in 2003. On-farm earning households and those earning from self-employment remitted to the wife's family in the home area more than they remitted to the husband's family. However, proportion of wage earning households remitting to the husband's family exceeded those remitting to the wife's family.

Table 7.8. Distribution of Positive Earning Farm Households That Remitted

Variable	% Remitting to husband's family	% Remitting to wife's family	% Remitting to home area
Households earning from farming only	26	32	26
Households earning from farming and self-employment	48	50	49
Household earning from farming and wage employment	51	45	51

Source: Author's Compilation from NWO Survey (2003).

Approximately 49 percent of self-employed households and 51 percent of households that engaged in wage employment remitted to the home area. These observations indicate that apart from earnings from on-farm work, remittances to the home area increase if the households participate in off-farm employments.

7.4. Empirical Strategy

Based on the previous discussions, the decision by the destination households to remit to the home area is influenced by household's earnings from on-farm and off-farm work; human capital investment; and other variables which link the out-migrant household to the home area. Having explained in detail some of these factors, this Section investigates these determinants empirically. The off-farm earnings variable comprises of earnings from wage employment and self-employment activities. Apart from earnings, livestock is a very important asset for rural migrants from the Northern Ghana and the liquidity problems of households with enough livestock such as cattle, sheep, goats and poultry are reduced tremendously. Other things being equal, households which earned more from on-farm work and off-farm employments and those with enough livestock wealth are expected to increase their remittances to the home area. These wealth variables are included in the model to examine their effect on annual remittances to the home area.

The human capital investment variables are years of formal education of husband and wife measured as years of primary or middle or Arabic, or other tertiary education. Greater responsibility is placed on highly educated migrants to remit because of the high level human capital investment on them by parents or relatives in the home area (Banerjee, 1981). The age of the household head is introduced into the remittance function to capture life cycle effects. Cox *et al.* (1998) have proposed a U-shaped relationship between age and remittances, an outcome which suggests that age

is affected by capital market imperfections. In particular, remittances are more likely to occur during periods when earnings are low and especially when the households are very young or old and less likely to occur when they are middle-aged. The propensity to remit is also very high if the out-migrant had an informal agreement with the home family. Examples of informal arrangements are the promise to remit regularly for the sustenance of wife, children, or old dependent relatives, occasional visits to the home area, and allowing wife, or children left behind or other relatives from the extended family to join the destination household when the out-migrant is fully settled at the migrant place of destination. If the out-migrant could not honour these obligations, he substitutes them with remittances.

Not all the sampled households remitted to the home area. So to correct for the sample bias problem, the Tobit model has been suggested in the literature (Banerjee, 1981; Maddala, 1983) to account for both remitting and non-remitting households. However employing the standard Tobit model would produce biased estimates because of the potential right hand side endogenous variables such as earnings and livestock wealth in the remittance functions. Previous studies provided by Johnson and Whitelaw (1974), Rempel and Lobdell (1978) and Lucas and Stark (1985) used ordinary least square (OLS) estimation despite its inconsistency by ignoring the problem posed by the zero observations in the remittance variable.

Banerjee (1981) did acknowledge the zero outcomes in the remittance variable and thus employed the Tobit estimation but failed to address the endogeneity problem posed by the earnings variables he introduced into his regression models. To obtain robust estimates for the remittance functions, current studies such as Gubert (2002) on Western Mali and De la Brière *et al.* (2002) on Dominican Republic migrants in the US have employed the 2-step instrumental variable (IV) Tobit approach which was originally proposed by Nelson and Olson (1978) and Newey (1987). Moreover, the Smith-Blundell (1986) exogeneity test is employed to test for weak exogeneity in the endogenous variables.

7.4.1. Specification of Remittance Function

The remittance function is specified as:

$$R_i = \alpha_i + \phi_i Y + \gamma_i K + \sum_{j=1}^{4} \lambda_{ij} H_j + \sum_{j=1}^{2} \delta_{ij} l_j + \sum_{j=1}^{N-1} \mu_{ij} d_j + \varepsilon_i \qquad (7.1)$$

where R_i is the annual cash and in-kind remittances from the destination households to the home area measured in Ghanaian Cedis (¢), $i = w$ for annual remittances to the wife's family in the home area and $i = h$ for annual remittances to the husband's family in the home area; Y denotes the total earnings from food crop production and off-farm employments such as wage employment and self-employment activities measured in Ghanaian Cedis (¢); K denotes livestock wealth measured in value terms in Ghanaian Cedis (¢); H represents household characteristics such as age and

human capital investment characteristics such as education of husband ; l_j denotes variables explaining how the amounts transferred from the destination households are influenced by linkages of the destination households to the home area. The home linkage variables include the informal agreements dummy ($l_1 = 1$; if the out-migrant household had reached some understanding with the home family before migration), and the inheritance claim dummy ($l_2 = 1$; if the out-migrant household has aspiration to inherit bequests such as cattle, land or house in the home area); d_j denotes location or village dummies; N is the number of location dummies; ε_i is the error terms; α_i is the intercept and; $\phi_i, \lambda_i, \gamma_i, \delta_i$ and μ_i are parameter estimates.

The household earnings Y and livestock wealth K are two potential endogenous variables. To obtain robust Tobit estimates, the simultaneity of the household wealth variables are corrected by expressing them in reduced form equations as:

$$Y = \rho_1 Z_1 + \eta_{1j} \tag{7.2}$$

$$K^* = \rho_2 Z_2 + \eta_{2j} \tag{7.3}$$

$$K = K^* \text{ if } K^* > 0 \text{ and } K = 0 \text{ if } K^* \leq 0$$

where Z_1 and Z_2 are vectors of identifying instruments for household earnings and livestock wealth respectively; ρ_1's and ρ_2's are vectors of parameters to estimate, and η_1, η_2 are error terms.

The two-step instrumental variables (IV) technique (Nelson and Olson, 1978; Newey, 1987) is then employed in the estimation of the reduced form equations. In the first step, the reduced form equation (7.2) is estimated with an ordinary least squares (OLS) since the earning variable presents no truncation problems[16] and also has no zero outcomes, and the reduced form equation (7.3) is estimated with a Tobit maximum likelihood since livestock wealth variable exhibited a number of zero observations. In the second step, the predicted values of earnings and livestock wealth are substituted in the remittance function (7.1) to be finally estimated with a Tobit maximum likelihood. The vector of identifying instruments should be exogenous to earnings and livestock wealth. The instruments for the earning variable include age at the time of migration, education of husband and wife, duration of stay[17] and dummies for lack of credit for farming, informal agreements, taungya land access[18] and some

[16] Data exists on Y and Z_1 variables for all the sampled households. Therefore according to Nelson and Olson (1978: pp 704) and Maddala (2001: pp 336), using OLS in the first step is appropriate.

[17] The effect of duration of stay on remittances was captured through the earning variable. Direct inclusion of duration of stay in the remittance model is problematic because as pointed out by Brown (1997) and Funkhouser (1995), with a single cross-section data, duration of stay captures not only the experience effect, but also the cohort and period effects.

[18] Taungya is a form of land access in Brong Ahafo where migrants are allowed to farm freely from a designated forest reserve. They only have to plant trees under the supervision of the local Forestry Department.

location dummies. Liquid wealth was instrumented by age at the time of migration, education of husband and wife, and dummies for taungya land access, informal agreements and some location dummies.

7.4.2. Empirical Results

Table 7.9 presents the standard Tobit and instrumental variable (IV) Tobit estimates of determinants of remittances to the wife's family. The dependent variable is the value of annual cash and in-kind remittances to the wife's family in the home area.

Table 7.9. Tobit Estimates of Determinants of Remittances to the Wife's Family

Variable	Standard Tobit		IV Tobit	
	Coefficient	t-ratio	Coefficient	t-ratio
Constant	-0.9343	-2.95***	-1.2735	-3.31***
Earnings†	0.0077	1.65*	0.0335	1.74*
Livestock wealth†	0.0001	0.07	0.0050	1.25
Age	0.0319	2.53***	.03015	2.33**
$(Age)^2/100$	-0.0311	-2.47**	-0.0295	-2.31**
Husband's education	0.0169	1.24	0.0326	2.02**
Earnings† * Husband's education	-0.0022	-0.97	-0.0044	-1.64*
Informal agreement dummy	-0.0453	-0.59	0.0919	0.76
Inheritance dummy	0.1193	1.82*	0.1223	1.86*
Aworopata	0.0841	0.99	0.1853	1.75*
Woraso	0.1998	2.82***	0.2208	2.96***
Dromankese	-0.0438	-0.47	0.0504	0.43
Log-likelihood	-73.87		-73.09	
Smith-Blundell Test F(2, 178)			0.60	
Number of observations	181		181	

Note: * Significant at 10%, ** significant at 5%, *** significant at 1%.
† Shows variables instrumented in the IV Tobit model.
Source: Author's Compilation from NWO Survey (2003).

The descriptive statistics of the variables used in the estimation of the remittance function are presented in Annex 7.1. The null hypothesis that earnings and livestock wealth are exogenous in the remittance function for the wife's family cannot be rejected since the *p*-value of 0.5523 for the *F*-value of 0.60 is not significantly different from zero even at 10 percent. The coefficient of earnings was positive and significant. The empirical result concurs with findings reported by Hoddinott (1994) for Kenya, and Gubert (2002) for Mali. The livestock wealth variable however did not have any significant influence on the amount remitted to the wife's family in the home area. These empirical results also imply that remittances to the wife's family are more influenced by earnings than household's liquid wealth from livestock. The remittance function for the wife's family shows an inverted U-shaped relationship with the age of the head of the household. The empirical results confirm Hoddinott's

(1994) and Gubert's (2002) assertion that remittances increase at the younger age but decreases with age. It however contrasts with Cox *et al* (1998) hypothesis and also what Schrieder and Knerr (2000) found for Cameroon.

The influence of the husband's education on remittances to the wife's family is captured by the education term and the multiplicative interaction term between education and earnings. This gave a positive effect. Hence, the positive significant impact of the husband's education on remittances to the wife's family is consistent with Banerjee's (1981) study for India and Gubert (2002) study for Mali. The informal agreements variable had the correct hypothesised sign but it was not significant even at 10 percent. The inheritance variable however had the anticipated positive sign and was statistically significant in both the standard Tobit and the IV Tobit models. The empirical results agree with the hypothesis that when inheritance claims within the households is high, remittances to the home area tend to increase (Lucas and Stark, 1985; Hoddinott, 1994; Subramanian, 1994).

Table 7.10. Tobit Estimates of Determinants of Remittances to the Husband's Family

	Standard Tobit		IV Tobit	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Constant	-0.3679	-0.59	-0.7490	-1.00
Earnings†	0.0212	2.07**	0.0327	0.79
Livestock wealth†	0.0024	1.33	0.0248	2.85***
Age	0.0159	0.63	-0.0014	-0.05
$(Age)^2/100$	-0.0163	-0.65	-0.0032	-0.12
Husband's education	0.0148	0.52	0.0430	1.23
Earnings† * Husband's education	-0.0036	-0.80	-0.0061	-1.10
Informal agreement dummy	0.0859	0.55	0.5987	2.36**
Inheritance dummy	0.0740	0.56	0.0484	0.64
Aworopata	-0.0719	-0.38	0.1469	0.64
Woraso	0.0039	0.02	0.0116	0.07
Dromankese	-0.0256	-0.14	0.1852	0.76
Log-likelihood	-181.58		-181.28	
Smith-Blundell Test F(2,178)			1.86	
Number of observations	181		181	

Note: * Significant at 10%, ** significant at 5%, *** significant at 1%.
† Shows variables instrumented in the IV Tobit model.
Source: Author's Compilation from NWO Survey (2003).

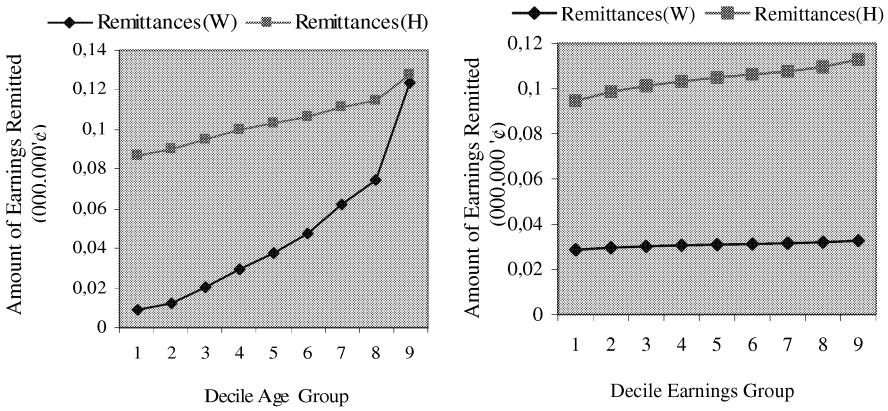
Table 7.10 contains the Tobit estimates of determinants of remittances to the husband's family. Descriptive statistics are provided in Annex 7.2. The *F*-value of 1.86 and *p*-value of 0.1582 from the Smith-Blundell (1986) exogeneity test indicate that the earnings and livestock variables are exogenous in the remittance function for the husband's family. In contrast to the remittances to the wife's family, the earnings variable in the IV Tobit model was not significant even at 10 percent. But the coefficient of the livestock wealth has a significant positive influence on remittances

to the husband's family. This finding agrees with Banerjee's (1981) proposition that when the household's earnings rise, remittances to the home area are expected to increase, *ceteris paribus*. In contrast to remittances to the wife's family, the human capital variables had the anticipated signs but none was even significant at 10 percent. The variable representing informal agreements between the out-migrant and the home family had a positive significant association with remittances to the husband's family. This result is in line with Banerjee's (1981) study for India and confirms our earlier proposition that if commitment to the home family through informal agreements is very high, remittances from the out-migrant to the home family tend to increase.

7.4.3. Simulations of Remittances to the Home Area

Household earnings and life cycle effects have been identified as important determinants in the remittance decisions of the rural farm households. We therefore employ simulations to investigate the changes that would occur in the proportion of earnings remitted due to changes in the age of the farmer and earnings from both on-farm and off-farm work. Figure 7.1 compares the simulation results of the amount of earnings remitted to the wife's family and the husband's family and Table 7.11 summarises the simulated results.

Figure 7.1. Simulation of Earnings Remitted to the Home Area



Source: Author's Compilation from NWO Survey (2003).

Along the same decile group of age, higher proportions of earnings are remitted to the husband's family than to the wife's family in the home area. However the amount of earnings remitted to wife's family increases at a faster rate than the amount remitted to the husband's family. As we move from the 1st to the 9th decile of distribution of earnings, simulations show a gradual rise in the amount of earnings remitted to the husband's family but a steady rise in the earnings remitted to the wife's family.

As indicated in Table 7.11, the net simulated effect on the amount of earnings remitted to the wife's family from the 1st to the 9th decile distribution of age is 12 percent whilst we observe an increase of approximately 0.4 percent for the decile earnings group. Similarly, the net simulated effect on earnings remitted to the husband's family along the same decile group of the distributions of age and earnings

Table 7.11. Simulation Results of Earnings Remitted to the Home Area

	Simulated Earnings Remitted to Home Area (000,000 '¢)					
Variable	Base Run (D_o)	1st Decile (D_1)	5th Decile (D_5)	9th Decile (D_9)	Simulated Net Effect (D_5-D_o)	Simulated Net Effect (D_9-D_1)
Wife's family						
Age	0.3065	0.0088	0.0379	0.1240	0.0291	0.1152
Earnings	0.0307	0.0287	0.0310	0.0327	0.0022	0.0039
Husband's family						
Age	0.1040	0.0868	0.1032	0.1275	0.0164	0.0406
Earnings	0.1040	0.0946	0.1049	0.1129	0.0103	0.0183

Source: Author's Compilation from NWO Survey (2003).

are 4 percent and 2 percent respectively. The simulated net effect on remittances to the husband's family however exceeds the amount remitted to the wife's family. The simulated result thus confirms the validity of the empirical results in which the flow of remittances to the wife's family was found to increase with age but earnings influenced the amount remitted to the husband's family.

7.5. Summary and Conclusions

This Chapter has the main focus on remittances from the destination rural migrant farm households to the home area. Investigating rural-rural remittances is a priori interesting and potentially makes a greater contribution than the infra-marginal study on international remittances and urban-rural remittances. Evidence from the farm household data revealed that remittance flows were not unidirectional because of the mutual-supporting role between the origin and destination households. However, remittances to the home area were skewed towards the husband's family. The mean annual remittance to the husband's family in the home area was ¢500,655 (US$59) while on average the annual remittances from the destination households to the wife's family were ¢194,333 (US$23). The determinants of remittances from the rural migrants to the home area were investigated and further quantified with simulations. One of the main claims to originality in this study relates to the investigation of the potentially diverging patterns of remittances to the husband's and wife's families in the home area. The empirical results show that remittances to the wife's family are influenced by earnings from on-farm and off-farm employments whilst this finding may not be true for remittances to the husband's family. This empirical finding clearly indicates how remittances are affected by the spouses' bargaining power. The

results also show an inverted U-shaped relationship between the age of the household head and the annual remittance to the wife's family in the home area. This is an important empirical finding of life-cycle effect on remittance which indicates that remittances increase at the younger age but decreases with age.

Apart from earnings and age, remittance flows from the destination migrants were motivated by factors which linked the out-migrants to the home area such as informal agreements and inheritance claims. In particular, households with high incidence of informal agreements increased annual remittances to the husband's family while those with inheritance claims increased the amount remitted to the wife's family. The finding that existence of inheritance claims increase remittances reflect the bargaining power of the receiving household when setting the terms of the informal agreement before migration occurs. The statistical results were also supported by simulations as the amount of earnings remitted to the husband's family was found to be higher when earnings from on-farm work and off-farm employments increase. The amount of earnings remitted to the wife's family however depended on age rather than earnings.

Annex 7.1

Descriptive Statistics of Variables Used in the Function Determining Remittances to the Husband's Family in the Home Area

Variable	Remitters (N=139)		Non-Remitters (N=42)		Total Sample (N=181)	
	Mean	Std. D	Mean	Std. D	Mean	Std. D
Remittances to husband's family†	0.50	0.62	0.00	0.00	0.38	0.58
Earnings	6.82	6.11	4.25	2.87	6.22	5.63
Livestock wealth	17.15	34.53	5.53	10.79	14.45	31.06
Age of head (years)	45.84	12.86	46.45	15.00	45.98	13.35
Age at the time of migration	32.34	12.33	31.88	15.27	32.23	13.03
Husband's years of schooling	1.91	3.85	2.43	4.40	1.11	3.27
Wife's years of schooling	1.04	3.23	1.31	3.41	1.11	3.27
Duration of stay (1-5 years)	0.22	0.41	0.19	0.40	0.21	0.41
Duration of stay (6-10 years)	0.29	0.46	0.29	0.46	0.29	0.46
Duration of stay (11-20 years)	0.30	0.46	0.29	0.46	0.30	0.46
Duration of stay (> 20 years)	0.19	0.39	0.24	0.43	0.20	0.40
Claim to inheritance dummy	0.78	0.42	0.71	0.46	0.76	0.43
Informal agreement dummy	0.89	0.38	0.88	0.33	0.89	0.36
Lack of credit dummy	0.35	0.48	0.43	0.50	0.36	0.48
Taungya dummy	0.14	0.35	0.17	0.38	0.15	0.36
Twimea-Nkwanta dummy	0.19	0.40	0.21	0.42	0.20	0.40
Nkwaeso dummy	0.17	0.37	0.12	0.33	0.15	0.36
Woraso dummy	0.14	0.35	0.17	0.38	0.15	0.36
Aworopata dummy	0.09	0.29	0.12	0.33	0.10	0.30
Ayerede dummy	0.29	0.46	0.26	0.45	0.29	0.45
Dromankese dummy	0.11	0.31	0.12	0.33	0.11	0.31

Note: Amount remitted, earnings and livestock wealth are in millions of Ghanaian Cedis (¢). Exchange rate: US$1=¢8500 in 2003. † The dependent variable..

Source: Author's Compilation from NWO Survey (2003).

Annex 7.2.

Descriptive Statistics of Variables Used in the Function Determining Remittances to the Wife's Family in the Home Area

Variable	Remitters (N=93)		Non-Remitters (N=88)		Total Sample (N=181)	
	Mean	Std. D	Mean	Std. D	Mean	Std.D
Remittances to wife's family†	0.19	0.24	0.00	0.00	0.38	0.58
Earnings	6.56	6.47	5.87	4.58	6.22	5.63
Livestock wealth	16.29	2.16	12.32	3.86	14.45	31.06
Age of head (years)	46.83	11.83	45.09	14.80	45.98	13.35
Age at the time of migration	33.05	11.37	31.36	14.59	32.23	13.03
Husband's years of schooling	2.01	3.82	2.06	4.16	11.05	326.51
Wife's years of schooling	1.54	3.77	0.67	2.57	1.11	3.27
Duration of stay (1-5 years)	0.20	0.41	0.22	0.41	0.21	0.41
Duration of stay (6-10 years)	0.29	0.46	0.30	0.46	0.29	0.46
Duration of stay (11-20 years)	0.31	0.47	0.28	0.45	0.30	0.46
Duration of stay (> 20 years)	0.19	0.40	0.20	0.41	0.20	0.40
Claim to inheritance dummy	0.84	0.37	0.68	0.47	0.76	0.43
Informal agreement dummy	0.89	0.31	0.89	0.41	0.89	0.36
Lack of credit dummy	0.38	0.49	0.35	0.48	0.36	0.48
Taungya land dummy	0.23	0.42	0.07	0.25	0.15	0.36
Twimea-Nkwanta dummy	0.23	0.42	0.17	0.38	0.20	0.40
Nkwaeso dummy	0.20	0.41	0.10	0.31	0.15	0.36
Woraso dummy	0.22	0.41	0.08	0.27	0.15	0.36
Aworopata dummy	0.14	0.35	0.06	0.23	0.10	0.30
Ayerede dummy	0.13	0.34	0.45	0.50	0.29	0.45
Dromankese dummy	0.09	0.28	0.14	0.35	0.11	0.31

Note: Amount remitted, earnings and livestock wealth are in millions of Ghanaian Cedis (¢). Exchange Rate: US$1= ¢8500 in 2003.

† The dependent variable in the remittance functions.

Source: Author's Compilation from NWO Survey (2003).

Chapter 8

Implications of Agricultural Activities for the Environment

Having analysed the income generation process of Upper East migrant farm households in Brong Ahafo, we focus our attention now on the implications of their agricultural activities on the quality of the environment (specifically, the quality of rented plots) in this Chapter. The differences between the migrants and others in the host area in terms of their agricultural activities and environmental consequences are also discussed. We also explore the effects of income or wealth levels of migrants and owners on the probability to undertake land improvements. In the transition zone of Brong Ahafo, settler farmers from Northern Ghana access plots under savanna, semi-forest and forest vegetations on short-term basis for crop production. These plots are periodically put to fallow by indigenous landowners to allow the natural vegetation to regenerate and improve the fertility of the soil. Moreover, indigenous landowners enrich fallowed lands with rapidly growing trees as means of raising the productivity of forest plots and upgrading savanna plots.

Migrant farm households are perceived as some of the principal actors in the environmental degradation process in the transitional zone. This is because of tenure insecurity, continuous cropping and lack of incentives to plant trees on plots which have been rented by them on short-term basis. Despite this dominant "savannisation" view concerning settler farmers, evidence from farm household data on Upper East migrant farm households in Techiman and the Nkoranza Districts of the Brong Ahafo Region show investments in soil fertility improvement methods on rented plots. The questions this Chapter seeks to address are as follows: What short-term and long-term soil fertility improvement methods do migrant farmers employ in maintaining the quality of rented plots? What determines migrant farmer participation in land improvement methods on rented plots? This Chapter is perhaps the most speculative segment of the current study because of data limitations associated with analysing environmental implications with cross-sectional data covering one year period.

To give a broader picture of the implications of agricultural activities within the savanna-forest transition zone, Section 1 reviews the relevant literature on environmental degradation in the transition zone of Ghana. This is complemented with satellite data (aerial photographs) showing changes which have occurred in the forest vegetation of the study area from 1990 to 2000 in Section 2. The land improvement methods employed on rented plots by migrant farm households are discussed in Section 3 based on the present study's farm household survey. The differences in behaviour of indigenous landowners towards land improvements are also discussed. The ability to invest in soil improvement methods may depend on the household's heterogeneity such as human capital endowments, demographic characteristics, the household's wealth, and other farm characteristics, so in Section 4

the effects of the determinants of the probability to invest in land improvement methods on rented plots are quantified with a probit model in addition to simulations. In particular, the empirical questions of whether the differences in income or wealth levels of migrants and indigenous landowners have environmental consequences and the effects of tenure differences on the propensity to undertake land improvements are answered. Conclusions are distilled in Section 5.

8.1. Environmental Degradation Discourse[19]

The forest-savanna transitional zone in Ghana constitutes a broad ecological area between the dry coastal savanna and the dry semi-deciduous forest zone. In the transition zone, farmers grow a variety of crops under the savanna and forest conditions. The implications of agricultural activities for the quality of the environment in the transition zone however have been controversial in the literature. While some argue in favour of gradual land degradation due to agricultural production and population growth, others have expressed opposing views to this "savannisation" hypothesis. Ecologists such as Roses-Innes (1964) and Hall *et al.* (1976) have described the transition zone as an area experiencing rapid land degradation reminiscent of the savanna of Northern Ghana mainly due to unsustainable land use by man. They argued that the selective removal of trees through felling or burning so as to open the forest canopy and allow sunlight through for cocoa and other food crop production is one of the catalysts of environmental degradation processes in the savanna-forest transition zone.

Moreover, after the 1983 drought and bush fire devastation in Ghana, most forests in Brong Ahafo became exposed and have continued to be subjected to annual bush burning. Settler farmers from the Northern Ghana in particular are perceived as one of the main contributors to the environmental degradation process through the way they farm on plots which have been leased to them on temporary basis. The dominant view is that during land preparation, immigrant farmers slash and burn, cut many trees and stump to make way for construction of mounds and ridges especially for yam cultivation, with the view that crops tend to be less productive under shady conditions (Amanor, 1993; Afikorah-Danquah, 1997). The aim of setting these bush fires to the land during land preparation for food crop production is to save time and cash.[20]

Furthermore, settler farmers often employ implements such as hoes which cut very deep into the soil. This farming practice earned them the name 'anti forest' or 'savanna people' by indigenous landowners in Brong Ahafo (Amanor, 1993). Due to

[19] Literature draws a lot from Amanor (1993), Afikorah-Danquah (1997); Fairhead and Leach (1996), Leach and Fairhead (2000), and informal discussions with Upper East migrant farm households and owner-cultivated households in Techiman and Nkoranza during the present study's farm household survey in 2003.

[20] An informal discussion with Abdul Karim Apiga, Upper East migrant farmer at Donkro-Nkwanta in Nkoranza District).

insecurity of land tenure arrangements, migrant tenants lack incentives to plant trees on rented plots, an attempt likely to be discouraged by landowners who are of the view that permitting tree planting on rented plots would lead to eventual claim of ownership of such lands by the migrant tenants (Leach and Fairhead, 2000). The perception then is that as landowners are enriching the soil's fertility with fallow and afforestation practices through tree planting, migrant tenants or charcoal burners on the other hand, may be reducing the vegetation cover and exploiting the land through continuous cropping on the same piece of land.

Recent studies however appear to refute most of the above 'savannisation' theories on the transition zone of Ghana. Current informed studies which are supported by historical data and ecological thinking seem to argue otherwise (Amanor, 1993; Afikorah-Danquah, 1997; Leach and Fairhead, 2000). The forest-savanna boundary for instance is believed to be stable since historical times and have not retreated as earlier works had proposed. Leach and Fairhead (2002) also show with historical evidence on Ghana and other parts of West Africa such as Guinea that farmers have been encouraging the formation of forest vegetation forms in the savanna through settlement strategies and agricultural practices.

Gyasi *et al.* (1994) note that specific cropping patterns have been adopted to offset the changing conditions in the biophysical environment in the transition zone. For instance, there is increasing preference for crop combinations such as maize and cassava compared with a combination like plantain and cocoyam, and the preferences for varieties of the same crops, such as cassava, that may be more suitable to the changing environmental conditions. Some farmers are incorporating leguminous crops such as cowpea and pigeon pea which continue to be the strategy for soil fertility regeneration before recropping. Afikorah-Danquah (1997) asserts that immigrant farmers in Brong Ahafo adopt forest management programmes that improve the forest vegetation. In the Wenchi District of Brong Ahafo, for example, Amanor (1994) finds that farmers have developed ecological management techniques by investing in labour rather than other inputs. Although migrant tenants may not fallow because of the pressure to crop all available land to meet food security needs, the other argument is that intensive cultivation of crops protect the soil from hard rainfall. According to Clay *et al.* (1995), poor farmers tend to invest more in resource conservation measures when they have available cash from off-farm employment. Amanor (1993) has pointed out that without acknowledging who is farming, and under what type of tenure arrangements, technology or labour allocation decisions, one cannot discuss effectively the impact of agricultural production on the forest vegetation in the transition zone of Ghana.

8.2. Vegetation Change in the Study Area

Before analysing what land improvement methods tenants employ on rented plots, the general vegetation condition of the study area is first explored with aerial photographs from 1990 to 2000. The satellite images give a broader picture on

whether the vegetation cover in the study locations in Brong Ahafo have improved or declined. Both images were captured between October and February so that seasonal variation in the vegetation cover for the two periods is controlled. Two important findings emerge from the satellite data. The vegetation cover appears to have deteriorated in predominantly urban cities in the Brong Ahafo Region but improved in predominantly rural areas of Techiman and Nkoranza Districts in the Brong Ahafo Region. Firstly, the loss of forest cover as captured by Figure 8.1 and Figure 8.2 is due to urbanization in major cities the Brong Ahafo Region. For example, the pictures clearly show the extent of forest degradation in Techiman and Nkoranza townships. This disappearance of vegetation cover in the two district capitals originates from the ever-increasing population growth in the region due to continuing influx of settlers from Northern Ghana resulting in rapid expansion of urban settlements.

Secondly, the images capture the vegetation condition in some rural locations where samples were taken for this study such as Aworopata and Akisumasu in the Techiman District These closely-knit villages and Woraso are located near the Asubima Forest Reserve where most farmers access forest plots for farming through the Taungya[21] system. For Nkoranza District, the images capture Donkro-Nkwanta which is also located in the Ayerede zone. Comparing the two pictures, it is clear that the vegetation cover in Akisumasu and Aworopata has seen some improvements during the decade (Figures 8.1 and Figure 8.2). Moreover, the forest vegetation in Donkro-Nkwanta in the Nkoranza District has also seen dramatic improvement in terms of vegetation growth during the periods under consideration. Generally, the source of the vegetation growth may be attributed to factors such as the increasing awareness among farmers on the need to improve the environment by planting trees and guiding against perennial bush fires in the districts. The Ministry of Lands and Forestry, and other environmental NGOs in recent times have been organising regional consultative workshops on National Wildfire Management Policies in Brong Ahafo. Such workshops draw participants and stakeholders from all the districts in the region where they are sensitised on the on-going Forest Plantation Development Programs, and National Wildfire Management Policy formulations disseminated. These crusades against wild and bush fires in Brong Ahafo might have paid off. Forestry intervention programmes have also sprung up in the Techiman and Nkoranza Districts. For example in 1997, the authorities from the Head Office of the Forestry Commission in Kumasi gave approval to farmers in the Techiman District to replicate the Taungya system in the Asubima Forest Reserve with the aim of preserving the forest resource through this modified form of agro forestry. Currently, there is a total of about nine groups comprising of both indigenous landowners and migrant tenants operating the Taungya within the reserve.

[21] Taungya is a form of land access in the Brong Ahafo Region of Ghana where migrants are allowed to farm freely from a designated forest reserve. They only have to plant trees under the supervision of the local Forestry Department as means of improving Ghana's forest.

Figure 8.1. Change Detection in Vegetation of Study Area in the Year 1990

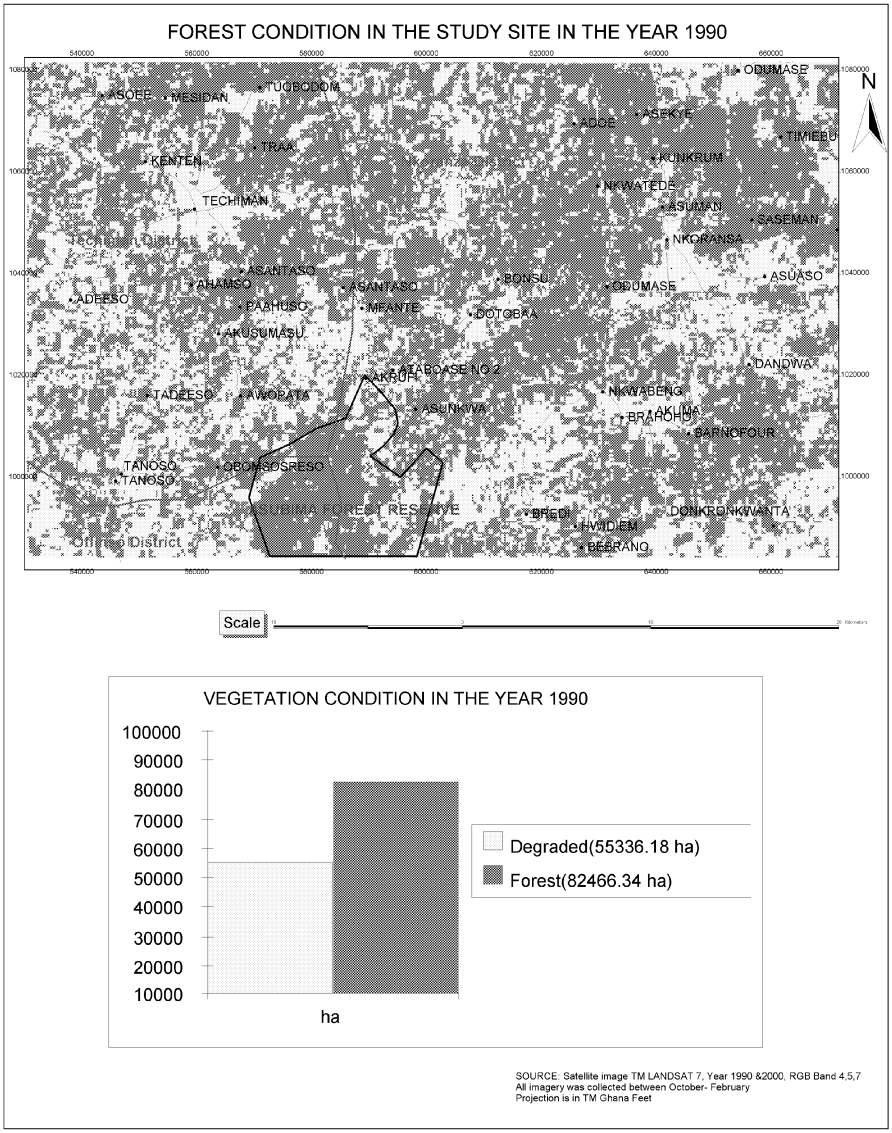
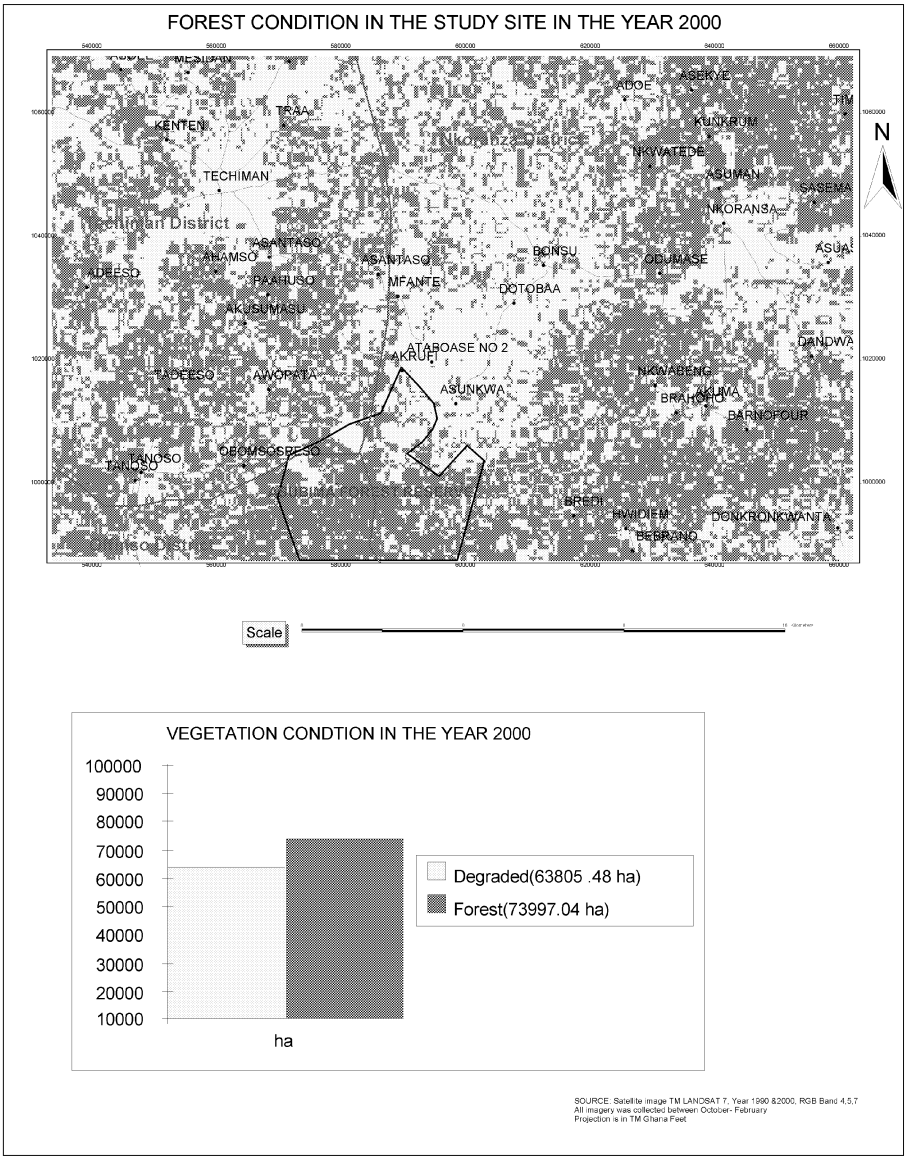


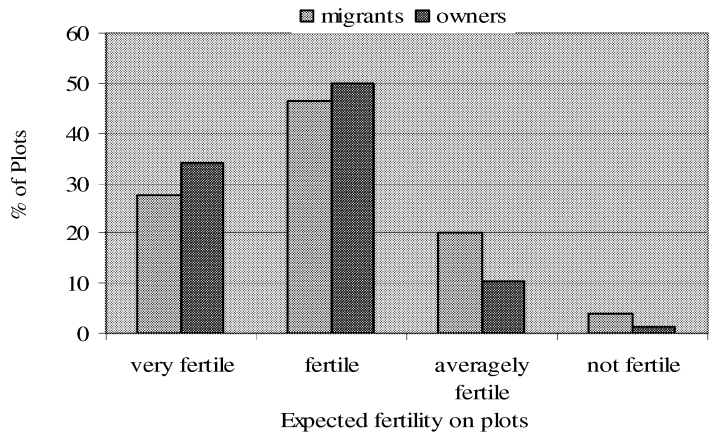
Figure 8.2. Change Detection in Vegetation of Study Area in the Year 2000



8.3. Investments in Land Improvement Methods

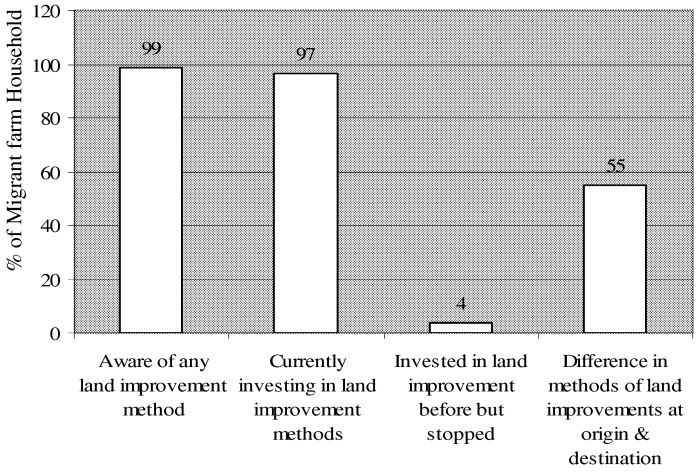
This Section discusses the short-term and long-term land improvement methods in which migrant tenants and owners invested on rented and owner-cultivated plots in Techiman and Nkoranza. Figure 8.3 compares the perceptions of farmers concerning

Figure 8.3. Expected Fertility on Plots



Source: Author's compilation from NWO Survey (2003).

Figure 8.4. Perceptions of Migrant Households Concerning Land Improvements



Source: Author's compilation from NWO Survey (2003).

soil fertility on the plots of these two different groups. Generally, owner-cultivated plots appear to be more fertile than rented plots of migrant farm households. Figure 8.4 also indicates a greater awareness among the farm households on methods that could be used to improve the quality of rented plots. Related to this fertility maintenance on plots, only a meagre 4 percent of the households have invested in some land improvement methods before and have stopped. Some differences also exist in the methods of soil fertility improvement at the migrant's place of origin and what migrants employ on rented plots at the destination.

8.3.1. Short-Term Land Improvement Methods

Table 8.1 compares the short-term improvement methods on rented plots and owner-cultivated plots. The short-term improvement methods are categorised under cultivation, agronomic and management practices, and erosion control measures. With the cultivation practices, zero tillage was practised only in Techiman with the proportion of owners using this method exceeding that of migrant farm households. Zero tillage was not observed among the farmers in Nkoranza probably due to the wider use of tractor for ploughing and ridging in Nkoranza. Minimum tillage is ranked first among the cultivation practices. It involves the use of hoes by farmers in the construction of mounds and ridges.

Table 8.1. Distribution of Short-Term Land Improvement Methods

Activity	% Migrant farm households		% Owner-cultivated households	
	Techiman	Nkoranza	Techiman	Nkoranza
Cultivation Practices				
Zero tillage	13		18	
Minimum tillage	67	64	85	97
Agronomic Practices				
Mulching	41	51	47	83
Crop rotation	38	68	64	65
Cover crops	3			
Management Practices				
Compost	4	18		41
Farm manure	23	16	22	7
Legume intercrop	61	78	73	83
Fertiliser application	43	67	69	62
Erosion Control				
Ditches	9	4	18	4
Ridging across slope	65	38	64	41

Source: Author's Compilation from NWO Survey (2003).

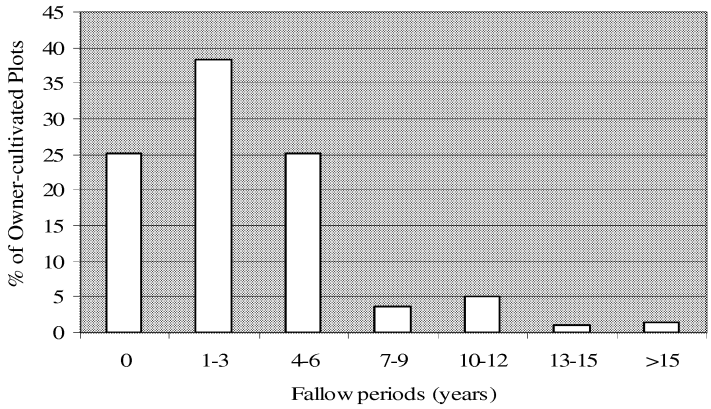
The use of mulch as soil fertility improvement is widely practised by farmers in Nkoranza more than in Techiman. The proportion of owners using mulch exceeds migrant farm households in both districts. Mulching involves the use of plant residues from the previous cultivation as a means of preventing the soil from direct impact of rains, sunshine and spread of bush fires. It also protects the soil from leaching, and suppresses the regeneration of unwanted weeds such as grasses. Mulching is mostly practised by yam cultivators. Among the listed agronomic practices, crop rotation was ranked first. Only a meagre proportion of the migrant farm households in Techiman plant mucuna as a cover crop. The most common soil management practices among the farm households are rotation of crops with legumes, application of fertiliser, manure and compost. Fertiliser application is higher among the migrant farm households in Techiman than in Nkoranza. Manuring was more prevalent on migrant plots than owner-cultivated plots. The most common soil loss prevention practice by migrants in Techiman is ridging across slope. Owners in Techiman employ ditches and ridging across slopes as erosion control measures. Generally, investments in soil fertility maintenance were higher than soil loss prevention.

8.3.2. Long-Term Land Improvement Methods

This Section explains the long-term sustainability investments among tenants and owners. The use of fallow for soil fertility enrichments is found only among owner-cultivated households. The fallow or rest period allows the natural vegetation to re-emerge to be used as natural fertiliser in the next cultivation period. Bush fallow is not a common practice among migrant farm households because tenants cannot afford to put plots which have been rented under short-term land-tenure arrangements such as fixed-rent and sharecropping to fallow. Fallow periods by owners are between 1-3 years and 4-6 years (Figure 8.5). Fewer owner-cultivated households put plots to fallow for a period of 15 years or more. Owners employ fallow as fertility enrichments more in Techiman than owners in Nkoranza.

The most significant long-term sustainability strategy is tree planting. Some of the predominant trees planted by the farmers include teak, cashew, oil palm, orange, mango, cocoa and indigenous trees. In addition to teak and cashew, a significant proportion of owner-cultivators in Nkoranza plant oil palm and mango purposely for income. Cocoa is an important tree crop in Brong Ahafo but none of the migrant farm households cultivated cocoa and only 2 percent of the sampled owner-cultivators in Techiman planted cocoa. Even in Nkoranza none was recorded among owners. Cocoa is mostly grown on a larger scale in the exclusive forest zones in the southern part of Brong Ahafo towards the Ashanti Region. Moreover, the sampled migrant farmers are predominantly food crop producers rather than migrant cocoa farmers.

Figure 8.5. Distribution of Fallow Periods on Owner-Cultivated Plots



Source: Author's compilation from NWO Survey (2003).

Apart from income generation, erosion control and prevention of yield decline, most indigenous landowners plant trees to secure title to plots. This observation agrees with a proposition by Besley (1995) that tree planting increases land rights. However, in his own words, land rights may decline if land is put to fallow (Besley ibid). Related to this hypothesis, Otsuka *et al.* (2003) have also observed in Southern Ghana that the extent to which land rights change after tree planting or fallow is difficult to measure. For most migrant tenants, trees were planted as part of tenure agreements between them and owners. In sharp contrast to the high incidence of short-term land improvements among migrant farm households, Table 8.2 shows less investment in trees by migrant tenants as compared to owner-cultivators. Migrant tenants who even plant trees are those located in Aworopata and Woraso in the Techiman District where the Taungya form of land access is prevalent. This is easily seen in Table 8.3 where a greater proportion of the migrant farm households gave afforestation as the main reason for planting trees. The criteria for entering into Taungya agreement with the Forestry Department is that the tenant must plant trees such as teak or cashew in the designated forest reserve where they are allowed to cultivate food crops. Seedlings and planting materials for the afforestation programme as indicated in Table 8.3 are provided by the Forestry Department from a community nursery.

Forestry intervention programmes are not peculiar to Ghana but to other sub-Saharan Africa countries such as Burkina Faso, Mali, Niger and Senegal as well. In Burkina Faso, the intervention programme is a multi-sectoral, decentralized and participatory concept referred to as village land management (VLM) where a village territory is managed by a responsible village group, with the aim of using the available natural resource in a way that assures sustainability and promotes the development of a system of tenure security within the group (*Programme Nationale*

Table 8.2 Distribution of Tree Planting Among Migrants and Owners

Activity	% migrant farm households		% owner-cultivated households	
	Techiman	Nkoranza	Techiman	Nkoranza
Trees planted				
Teak	29	8	24	33
Cashew	4	5	24	47
Oil palm	2			20
Orange				7
Mango	4	7	4	13
Cocoa			2	
Indigenous trees			2	
Area of trees				
1 – 5	35	12	43	63
6 – 10	2		7	7
> 10			2	
Planting year				
1990 – 2000	9	4	42	57
> 2000	28	8	13	10

Source: Author's Compilation from NWO Survey (2003).

Table 8.3. Reasons for Planting Trees

	% migrant farm households		% owner-cultivated households	
	Techiman	Nkoranza	Techiman	Nkoranza
Reasons				
Check erosion	2			
Yield declines			2	
Tenure agreement			16	
Earn income	18	11	31	67
Secure title to plot			7	3
Afforestation	19	1	7	
Seedlings				
Purchased	5	11	13	63
Own nursed seeds	3	1	7	3
Community nursery	29		27	3
Maintenance				
Manual weeding	32	11	42	67
Use of herbicides	1	1		27
Pruning	3	3	16	33
Fire lines		1	11	

Source: Author's Compilation from NWO Survey (2003).

de Gestion des Terrioirs-PNGT, Burkina Faso, 1991). Community afforestation has also become an institutionalised feature and priority of forestry services in Mali and

Niger (Gueye and Laban, 1994). For example, in the groundnut basin of Senegal, the FAO and the Senegalese government initiated such community reforestation programme in 1982. Gueye and Laban (ibid) report that forestry activities were carried out in more than 3000 villages in Burkina Faso (of a total of around 7,500). In Senegal it was between 1,000 and 1,500; and over 1,000 in Mali where they depended on village tree nurseries.

In Techiman and Nkoranza, owner-cultivators who plant own trees purchase their own seedlings and planting materials or nurse the seedlings themselves. Those involved in community afforestation programmes rely on seedlings and planting materials from the community nursery. The acreages of trees planted by tenants and owners were between 1-5 acres. Most trees were planted by owners between 1990 and 2000, a period which agrees with the satellite data on the study area. A large percentage of migrant tenants also started tree planting after 2000.

8.4. Environmental Costs of Agricultural Production

The costs to the environment are quantified in terms of trees removed during land preparation for agricultural production. These are trees found on the plots before the farmers acquired them. They include indigenous trees and mahogany rather than teak, cashew, oil palm, mango and so on which are planted purposely by farmers for economic reasons. Table 8.4 summarises these previous trees and Figure 8.6 provides some information on trees removed per acre from rented and owner-cultivated plots. As indicated in the figure, for each category of tree removed per acre, the proportion of owner-cultivated plots was higher than rented plots of migrant tenants. In general, farmers in Nkoranza cut more trees during agricultural production than farmers in Techiman. The proportion of farmers using forest plots is significantly higher in Nkoranza than in Techiman where forest plots are in serious short supply.

8.5. Empirical Considerations

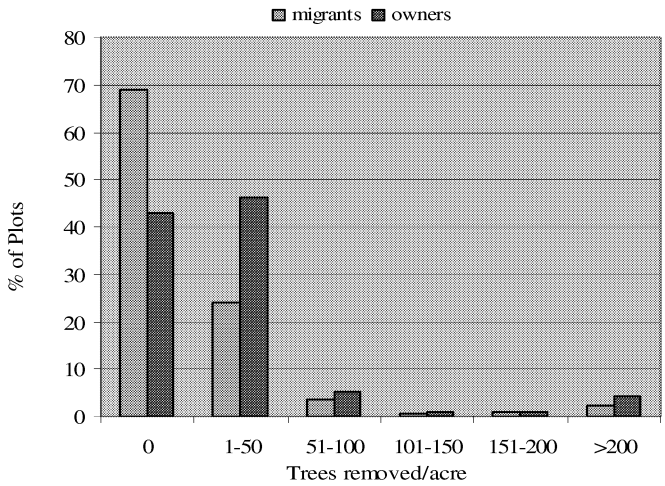
This Section quantifies the effects of the determinants of the probability of investing in short-term and long-term land improvement methods. The short-term improvements include mulching, crop rotation with legumes, manuring, application of fertilizer, construction of ditches and ridging across slopes. Although short-term investments in land improvements have short payback periods, they could also affect the productivity of the land even in future cropping seasons. For the long-term improvements, we consider the probability to invest in trees (both owners and tenants) and fallow (only owners). The dependent variable for investment in land improvement is a discrete choice variable in this sense that it measures whether the farmer has undertaken improvements on his plot since he acquired (rented) it.

Table 8.4. Distribution of Previous Trees on Rented and Owner-Cultivated Plots

Previous trees	% migrant farm households		% owner-cultivated households	
	Techiman	Nkoranza	Techiman	Nkoranza
Teak	6	1	2	
Cashew	11	1	18	
Oil palm	11	5	16	
Orange	4		4	
Mango	14		11	
Cocoa	1			
Mahogany	25	25	27	73
Indigenous trees	41	45	40	47
All	74	63	76	77

Source: Author's Compilation from NWO Survey (2003).

Figure 8.6. Removal of Trees from Rented and Owner-Cultivated Plots



Source: Author's Compilation from NWO Survey (2003).

The ability of the farm households to invest in land improvement methods on a plot would depend on the household's heterogeneity in terms of its wealth and human capital endowments. Other farm characteristics including the amount of land cultivated, previous soil fertility status measured as the fallowed years before acquisition of plot and the distance of plot from home may also influence the probability to invest in a land improvement method on a particular plot. The wealth of the household includes livestock and earnings from off-farm employments. However, to be able to estimate the probability of investing in any of the listed land improvement methods, we run into simultaneity problems since most of the determinants of participation by migrant farm households such as land cultivated, off-

farm earnings and livestock wealth cannot be treated as exogenous in the relevant investment equations. In a similar study by Besley (1995) in which Ghanaian farm household data were employed, the endogeneity problems posed by the amount of land cultivated by tenants, off-farm earnings and livestock wealth were not taken into account.

8.5.1. Specification of the Empirical Models

Assuming that the propensity to invest in land improvement method on a plot *i* by the farm household is a latent variable S_i^*, we can specify the land improvement investment function as:

$$S_i^* = a_0 + a_1(land)^* + a_2(earnings)^* + a_3(livestock)^* + a_4' z_1 + e_1 \quad (8.1)$$

where z_1 is a vector of household and plot-level characteristics, and some location dummies; a_1, a_2, and a_3 are parameter estimates for land, off-farm earnings and livestock wealth respectively and a'_4 is a vector of parameters for household and plot-level characteristics, and location dummies; a_0 is the intercept and e_1 is the error term.

Since S_i^* is unobserved, we only observe a dummy variable S_i defined by:

$$S_i = \begin{cases} 1 \quad if \ S_i^* > 0 \\ 0, \ otherwise \end{cases} \quad (8.2)$$

where S_i =1 if the farm household has invested in the land improvement method on the plot *i* since he acquired it and 0 otherwise.

If the error term e_1 in (8.1) follows a standard normal distribution, then the probability to invest in land improvement method is quantified using a probit model:

$$P(S_i = 1) = \int_{-\infty}^{S_i/\sigma} \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} dt \quad (8.3)$$

According to Maddala (2001), the likelihood function to be maximised through nonlinear estimation method can be expressed as:

$$L = \prod_{S_i} P_i \prod_{S_i=0} (1 - P_i) \quad (8.4)$$

As already noted, the endogeneity problem posed by the amount of land cultivated, off-farm earnings and livestock wealth need to be eliminated for robust estimates. This is achieved by re-specifying the investment equation (8.1) as a system of simultaneous equations where each of the endogenous variables are expressed in a

reduced form equation comprising of only right-hand side exogenous variables. First, the reduced form equation for acreages under tenancy contracts is expressed as:

$$(land)_j^* = b_0 + b_1(earnings)^* + b_2(livestock)^* + b_3' z_2 + e_2 \quad (8.5)$$

where j =1 if land is cultivated under fixed-rent contract and j =2 if land is cultivated under sharecropping contract; z_2 is a vector of household and farm characteristics and some location dummies; b_1 and b_2 are parameter estimates for off-farm earnings and livestock wealth and b'_3 is a vector of parameters for household and farm characteristics and some location dummies; b_0 is the intercept term and e_2 is the error term.

However, earnings from off-farm employments and livestock wealth cannot be considered exogenous in (8.5). Hence these endogenous variables are further expressed in separate reduced forms (8.6) and (8.7) where the right hand side variables are now weakly exogenous (Smith and Blundell, 1986).

$$earnings = c_0 + c_1' z_3 + e_3 \quad (8.6)$$

$$livestock = d_0 + d_1' z_4 + e_4 \quad (8.7)$$

where z_3 and z_4 are vectors of exogenous variables explaining off-farm earnings and livestock wealth; c_1 and d_1 are vectors of parameter estimates; c_0 and d_0 are intercept terms; e_3 and e_4 are the error terms.

8.5.2. Estimating the Models

Following the methodology proposed by Smith and Blundell (1986) for simultaneous equation Tobit models, the land improvement investment equation (8.1) for migrant farm households is estimated in 3 steps. In the first step, the reduced form equations (8.6) and (8.7) are estimated with a Tobit maximum likelihood since both off-farm earnings and livestock wealth contain a number of zero observations. The predicted values of off-farm earnings and livestock wealth are then substituted in the reduced form equation (8.5) in the second step, for the new equation to be estimated with a Tobit maximum likelihood. The Tobit model is again appropriate in this step, because of possible zero observations associated with land area cultivated under either fixed-rent or sharecropping contracts. The estimated fixed-rent and sharecropped land, together with the estimated off-farm earnings and livestock wealth are finally substituted into the land improvement investment equation (8.1) for the final model to be estimated with a probit model.

The empirical models are estimated on plot-level separately for migrant farm households and owner-cultivated households. This allows comparison of the level of investments among tenants and owners. Hence a similar estimation procedure is followed for owner-cultivated households. However in the case of owners, acreages

under cultivation are assumed exogenous. The estimation of equation (8.5) in the second step is therefore skipped. This approach departs from Besley (1995) in which the right of ownership by owner-cultivators was considered endogenous. The endogeneity problem posed by landownership of owner-cultivators was ignored in the present study because of data limitations.

The instruments for off-farm earnings in the model for migrant farm household include age, age squared, education and education squared. Livestock wealth was instrumented by age, age squared, education and dummies for religion and veterinary visits. In addition to the estimated land variables, duration of stay, distance of plot from home and previous fallowed years of plot were included to examine their influence on the land improvement participation on plots. Similarly, off-farm earnings of owners were instrumented by age, education and education squared. Livestock wealth of owners was also instrumented by age, education, some demographic characteristics, and dummies for religion and veterinary visits. Off-farm earnings and livestock wealth were measured in Ghanaian Cedis (¢), land cultivated in acres, age of household head in years. Education refers to years of formal education of the household head. Age and education proxy for skills and experience of the farmer.

8.5.3. Empirical Results

Descriptive statistics of the variables used in the estimation of the participation equations are contained in Table 8.5. The empirical estimates on the probability to invest in a land improvement method by the migrant farm households are provided in Table 8.6. Although the estimates from the reduced form equations for land improvement participation are difficult to interpret, they nevertheless provide some idea on the choice of land improvement on rented and owner-cultivated plots. The empirical results indicate that highly educated and experienced farmers undertake erosion control measures such as construction of ditches on rented plots but decrease investment in farm manure. Statistically, the probability to invest in either short-term or long-term improvements among the migrant farm households is very responsive to the duration of stay. In particular, the probability to invest in short-term erosion control measure such as ridging across slope decreases with duration of stay but construction of ditches increases with duration of stay. Investment in soil management practices such as mulching or application of farm manure is higher on plots of migrant farm households with longer duration of stay than recent arrivals. The probability to invest in fertiliser or in trees on rented plots also increased with shorter duration of stay.

The probability to improve fixed-rent plots with farm manure or leguminous plants is low but high for improved technology such as fertiliser. On sharecropped plots, the use of farm manure, mulch and application of fertiliser also increased. Because of possible tenure insecurity on rented plots, we expect the probability to invest in long-term land improvements on fixed-rent and sharecropping plots to be

lower, *ceteris paribus*. As expected, investments in trees had the anticipated negative signs for both fixed-rent and sharecropped plots. Moreover, the probability to invest in trees on plots rented under fixed-rent contracts was not even significant at 10 percent. Households with higher earnings from off-farm employments decrease investments in farm manure and mulch but increase investments in trees on rented plots. Those with higher livestock wealth also increase the use of farm manure on rented plots. The empirical result is not surprising because of the use of livestock droppings or waste as manure for soil fertility improvement. The propensity to invest in mulch or legumes also appears to be low on plots of households with more liquid wealth. The empirical results also indicate fewer investments in trees and farm manure when the distance of rented plot is far away from home. However, mulching increase on such plots. Again, mulching increase on plots with higher previous years of fallow but investment in trees increase on plots with less previous years of fallow.

We now turn the attention on empirical estimates on land improvement participation of owner-cultivated households. The descriptive statistics of the variables used in the estimation have been provided in Table 8.5 and the estimation results are reported in Table 8.7. Similar to the migrant farm households, the propensity to invest in the construction of ditches decreases for highly educated and experienced owner-cultivators. Also investment in trees decreases on plots of highly educated owner-cultivators. The probability to invest in either farm manure or mulch is high on plots of owner-cultivators with less acreage. This empirical result is similar to tenants with fixed-rent plots but contrasts with those with sharecropping plots. Moreover, the probability to invest in fertiliser on owner-cultivated plots is high for those with larger acreages, a result similar to what was found for migrant tenants with tenants with fixed-rent and sharecropped plots respectively. Acreages of owner-cultivators were also responsive to long-term investments. For example, the tendency for owners to allow plots to regain fertility through bush fallow increased for those endowed with larger acreages.

Similar to what occurred on rented plots, owners with high off-farm earnings do not rely much on the construction of ditches, or the use of farm manure or mulch as soil quality improvement, *ceteris paribus*. In contrast to plots of migrant tenants, investments in trees decrease for owners with high off-farm earnings. The effect of livestock wealth on the probability to invest in farm manure or mulch on owner-cultivated plots was similar to what occurred on rented plots but contrast with the results on the probability to invest in legumes for migrant tenants. Other things being equal, higher livestock wealth tends to increase the probability of investing in soil fertility enrichment such as rotation of crops with legumes but fewer investments in mulch on owner-cultivated plots. However, if the plots of owners are far away from home, fertility enrichment through bush fallow tend to decrease.

Table 8.5. Descriptive Statistics of Variables Used in the Regressions

	Rented plots (N=346)		Owner-cultivated plots (N=214)	
	Mean	S.d	Mean	S.d
Dependent variables				
Ridging across slope	0.47	0.50	0.28	0.45
Ditches	0.07	0.25	0.10	0.30
Farm manure	0.18	0.39	0.07	0.25
Mulch	0.36	0.48	0.34	0.48
Legumes	0.39	0.49	0.44	0.50
Fertiliser	0.44	0.50	0.39	0.49
Trees	0.76	0.43	0.31	0.46
Fallow			0.74	0.44
Explanatory variables				
Acreage under fixed-rent †	1.60	2.47		
Acreage under sharecropping†	0.79	1.58		
Duration of stay	13.95	9.57		
Land cultivated††			12.36	17.28
Distance of plot from home	4.40	4.03	0.15	2.11
Previous years of fallow	4.61	5.65	3.36	3.40
Off-farm earnings†	2.88	5.41	2.50	6.02
Livestock wealth†	15.52	32.21	4.21	54.61
Education	1.93	3.86	6.72	4.91
Aworopata	0.09	0.29	0.19	0.39
Woraso	0.21	0.41	0.13	0.33
Ayerede	0.26	0.44	0.28	0.45
Dromankese	0.08	0.26	0.10	0.30

Note: The dependent variable is a dummy variable =1 if land improvement method is undertaken on a plot and 0 otherwise. Earnings and livestock wealth are in millions of Ghanaian Cedis (¢), Exchange rate: US$1=¢8500 in 2003; land cultivated in acres; fallowed years, education, and duration of stay in years; distance of plots from home in kilometres (km).

† Represents variables instrumented in the regression models.

†† Refers to the amount of land cultivated by landowners.

Source: Author's Compilation from NWO Survey (2003).

Table 8.6. Probit Estimates of Determinants of Land Improvement Participation on Rented Plots

Variable	Ridging across slope	Ditches	Farm manure	Mulch	Legume	Fertiliser	Trees
Intercept	-0.2392	-2.4115	0.6498	0.9254	-0.6092	0.8832	0.7897
	(-0.47)	(-2.52)***	(0.94)	(1.70)*	(-1.42)	(1.54)	(1.26)
Education	-0.0087	0.0666	-0.1684	0.0106	0.0456	0.0188	0.0223
	(-0.37)	(1.76)*	(-3.52)***	(0.44)	(1.38)	(0.76)	(0.76)
Duration of stay	-0.1067	0.3337	0.2017	0.1283	-0.0336	0.0502	-0.1824
	(-3.00)***	(3.60)***	(3.49)***	(3.15)***	(-0.87)	(1.38)	(-3.23)***
(Duration of stay)^2	0.0022	-0.0085	-0.0057	-0.0038	0.0010	-0.0022	0.0054
	(2.24)**	(-2.93)***	(-3.43)***	(-3.35)***	(0.91)	(-2.06)**	(3.21)***
Fixed-rent land (est'd)	-0.0512	0.0552	-0.2802	0.0689	-0.3313	0.5234	-0.1951
	(-0.47)	(0.28)	(-1.67)*	(0.58)	(-2.50)***	(4.01)***	(-1.51)
Sharecropped land (est'd)	-0.2242	0.5421	1.1048	0.8321	0.0758	0.5643	-0.7872
	(-1.05)	(1.37)	(3.33)***	(3.37)***	(0.30)	(2.37)**	(-2.76)***
Off-farm earnings (est'd)	0.0913	-0.0332	-0.5019	-0.3066	-0.0191	0.0044	0.2544
	(1.29)	(-0.27)	(-4.38)***	(-3.97)***	(-0.25)	(0.06)	(2.72)***
Livestock wealth (est'd)	0.0052	0.0003	0.0150	-0.0232	-0.0157	0.0045	-0.0018
	(0.90)	(0.03)	(1.89)**	(-3.64)***	(-2.43)**	(0.73)	(-0.23)
Distance of plot from home	0.0205	-0.0572	-0.0510	0.0392	0.0265	0.0223	-0.0623
	(1.12)	(-1.40)	(-1.75)*	(1.82)*	(1.38)	(1.20)	(-2.98)***
Fallowed years of plot	-0.0086	-0.0406	0.0085	0.0372	0.0069	-0.0133	-0.0379
	(-0.61)	(-1.32)	(0.51)	(2.56)***	(0.43)	(0.90)	(-2.21)**
Aworopata	1.6921	-0.3658	-2.0370	-1.2538	0.0402	-0.2984	-0.1751
	(4.16)***	(-0.67)	(-3.97)***	(-3.15)***	(0.10)	(-0.74)	(0.32)
Woraso	-0.0817			1.1816	1.9726	0.2822	-2.8951
	(-0.20)			(2.31)**	(4.12)***	(0.64)	(-4.67)***
Ayerede	0.1050	0.1048	1.6517	1.1948	-0.0800	1.2623	-0.5033
	(0.35)	(0.17)	(3.40)***	(3.36)***	(-0.23)	(3.88)***	(1.06)
Dromankese	0.3856	-0.9429	0.4211	0.0454	0.8567	0.4071	-0.6574
	(1.20)	(-1.43)	(0.85)	(0.13)	(2.52)***	(1.21)	(1.58)
Pseudo R^2	0.0857	0.2262	0.2238	0.2138	0.2134	0.1596	0.3227
Log-likelihood ratio	- 218.63	-61.05	-114.47	-177.03	-181.67	-199.61	-128.32
No. of observations	346	273	273	346	346	346	346

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%. Source: Author's Compilation from NWO Survey (2003).

Table 8.7. Probit Estimates of Determinants of Land Improvement Investment on Owner-Cultivated Plots

Variable	Ridging across slope	Ditches	Farm manure	Mulch	Legume	Fertiliser	Trees	Fallow
Intercept	-1.1935	0.5665	2.3401	0.1396	-1.1494	-0.7352	-0.7230	0.5456
	(2.70)***	(0.90)	(1.66)*	(0.34)	(2.80)***	(-1.81)*	(-1.64)*	(1.18)
Education	-0.0192	-0.1413	-0.0966	-0.0038	0.0185	-0.0043	-0.0424	0.0367
	(-0.77)	(-2.86)***	(-1.50)	(-0.16)	(0.82)	(-0.18)	(-1.73)*	(1.40)
Land	0.0077	0.0040	-0.4175	-0.0134	0.0073	0.0144	0.0039	0.0242
	(1.32)	(0.45)	(-3.25)***	(-2.04)**	(1.29)	(2.41)**	(0.70)	(2.46)***
Off-farm earnings (est'd)	0.0499	-0.1513	-0.4842	-0.0899	0.0214	0.0093	-0.0986	0.0707
	(1.21)	(-1.67)*	(-3.08)***	(-2.17)**	(0.55)	(0.24)	(-2.16)**	(1.56)
Livestock wealth (est'd)	0.0324	-0.0605	-0.0059	-0.0726	0.1184	0.0338	0.0548	0.0767
	(0.69)	(-0.95)	(-0.07)	(-1.65)*	(2.69)***	(0.78)	(1.16)	(1.62)
Distance of plot from	-0.0016	-0.0157	0.0649	-0.0255	-0.0460	-0.0134	0.0126	-0.0689
Home	(-0.02)	(-0.39)	(0.68)	(-0.71)	(1.40)	(-0.43)	(0.28)	(-1.64)*
Fallowed years of plot	0.0087	0.0005	-0.03784	0.0204	0.0136	-0.0188	-0.0163	
	(0.30)	(0.01)	(-0.46)	(0.72)	(0.48)	(-0.67)	(0.57)	
Aworopata	0.7128	-0.2847	-1.3428	-0.0098	0.4221	0.4983	0.7843	-1.1306
	(2.29)**	(-0.77)	(-2.40)**	(-0.04)	(1.45)	(1.77)*	(2.59)	(-3.65)***
Woraso	0.7151	-0.0122		-0.5254	0.7115	0.3400	0.1695	-0.9003
	(2.26)**	(-0.03)		(-1.34)	(2.36)***	(1.12)	(0.49)	(2.70)***
Ayerede	0.4463	-1.1063		0.7441	0.6665	0.5489	0.5272	-0.8628
	(1.55)	(2.50)***		(2.79)***	(2.49)***	(2.06)**	(1.85)*	(-2.80)***
Dromankese	-0.7542		1.5063	-0.2222	0.8312	-0.1629	1.5372	
	(1.35)		(1.97)**	(-0.56)	(2.21)**	(0.41)	(3.83)***	
Pseudo R^2	0.0998	0.1135	0.3332	0.1222	0.0790	0.0675	0.1134	0.1653
Log-likelihood ratio	-113.44	-58.86	-29.46	-120.56	-135.37	-133.68	-117.93	-97.03
No. of observations	214	193	128	214	214	214	214	193

Note: *** Significant at 1%, ** significant at 5%, * significant at 10%.
Source: Author's Compilation from NWO Survey (2003).

8.5.4. Simulating the Effect of Off-farm Earnings

The empirical results reported in the previous section indicate that off-farm earnings and other variables such as duration of stay, distance of plot from home and previous fallowed years of plot have significant influence on the choice of land improvement method tenants invest on rented plots. But how large are these effects on the probability to invest in any of the listed land improvement method? To answer this question, the probit estimation results are used to simulate the importance of these variables. In a first simulation, the probabilities for each household to invest in the listed land improvement method on rented plots are calculated using the estimated coefficients and the actual values for the variables included in the estimation. This yielded the base run scenario. In a second scenario, earning from off-farm employments for each household is halved and the probabilities to invest in the land improvement methods are again calculated under this scenario using the actual values for all variables included in the model. The same procedure is employed for simulations involving duration of stay, distance of plot from home and previous fallowed years of plots.

The simulation results are shown in Table 8.8. When we compare the base run simulations with the scenario when off-farm earnings of the migrant farm households is halved we found out that the model predicts more investment in tree planting and ridging across slope than other land improvement methods. In terms of absolute changes however, investments in farm manure and mulch are higher than the rest. In the case when duration of stay is reduced to a half, we observe higher investments in farm manure, mulch, ditches and fertiliser respectively. Similarly, the model predicts less investment in tree planting, farm manure and ditches when the distances of plots from home are reduced by half. When previous years of fallow are halved, tenants increase investments in mulch, legumes and the use of farm manure.

8.6. Summary and Conclusions

This Chapter has analysed the implications of the agricultural activities of Upper East migrant farm households on the quality of the environment in Brong Ahafo Region. The differences between the migrants and indigenous landowners regarding environmental improvement have also been highlighted. Despite lack of incentives to undertake long-term investments on plots which have been rented on temporarily basis, migrant tenants made some effort to invest in short-term land improvements on rented plots. In terms of short-term land improvement methods, much difference was not found between what migrants and indigenous landowners do. However, indigenous landowners could undertake long-term investments by planting trees such as teak, cashew, oil palm and mango. Only migrants with access to taungya plots (which enabled them to undertake food crop production freely in a designated forest

Table 8.8. Simulations on Land Improvement Investment on Rented Plots

Land improvement methods	Off farm earnings (¢)			Duration of stay (years)			Distance of plot from home (km)			Fallowed years of plot (years)		
	P_1	P_2	ΔP	P_1	P_2	ΔP	P_1	P_2	ΔP	P_1	P_2	ΔP
Ridging across slope	0.036	0.073	0.037	-0.042	-0.085	0.043	0.008	0.016	0.008	-0.003	-0.007	0.003
Ditches	-0.002	-0.005	0.002	0.024	0.049	0.024	-0.004	-0.008	0.004	-0.003	-0.081	0.078
Farm manure	-0.114	-0.228	0.114	0.046	0.092	0.046	-0.012	-0.023	0.012	0.002	0.004	0.002
Mulching	-0.109	-0.218	0.109	0.046	0.091	0.046	0.014	0.028	0.014	0.013	0.026	0.013
Legume	-0.007	-0.014	0.007	-0.012	-0.025	0.013	0.010	0.020	0.010	0.003	0.005	0.003
Fertiliser	0.002	0.004	0.002	0.020	0.040	0.020	0.009	0.018	0.009	-0.005	-0.010	0.005
Tree planting	0.062	0.123	0.062	-0.044	-0.088	0.044	-0.015	-0.125	0.110	-0.009	-0.018	0.009

Note: Simulations show absolute change ($\Delta P=P_2-P_1$) in the probability of investing in a particular land improvement method when off-farm earnings or duration of stay or plot distance or previous fallowed years of plot are halved.
The mean off-farm earnings reduced from ¢2.88 million to ¢1.43 million when off-farm earnings for each household in the sample is halved.
The mean duration of stay reduced from 13.5 years to 6.9 years when duration of stay for each household in the sample is halved.
The mean plot distance reduced from 4.4 km to 2.2 km when plot distance of each plot from home is reduced to a half.
The mean previous fallowed years reduced from 4.6 years to 2.3 years when previous years of fallow for each plot in the sample are halved.

Source: Author's Compilation from NWO Survey (2003).

reserve) could participate in forestry intervention programs where trees such as teak and cashew were planted as a means of improving the forest vegetation in Brong Ahafo Region. Very few of them sharecropped mango and oil palm with indigenous landowners. In addition to the tree planting, owners employed the traditional bush fallow system, an improvement method which migrants could not do irrespective of the fallow period because of the disincentive such as tenure insecurity associated with plots which have been rented on short term basis. Some of the prospects for migrants include long-term tenure arrangements between them and owners where trees could be sharecropped and the possibility of re-entering into new contract terms that ensures continuity of producing crops which improve the relative income positions of the migrants.

The determinants of the probability to invest in short-term and long-term land improvement methods on rented and owner-cultivated plots were also quantified. Two empirical questions of whether tenure differences play any role in land improvement activities of migrants and whether the differences in income levels of migrants and owners affect their propensity to undertake short-term or long-term investments were considered. The empirical results revealed that migrants with fixed-rent plots undertake less investment in legumes and farm manure but employed more fertiliser. Sharecroppers on the other hand, employed more farm manure, fertiliser and mulch as fertility improvements but undertook less investment in trees.

The empirical results showed very few differences on the effect of income levels of migrants and owners on the probability to invest in land improvement methods. For instance, while migrants with higher off-farm earnings have higher probability to invest in trees, the opposite is the case for indigenous owner-cultivators. Moreover, owners with enough liquid wealth tended to employ more leguminous plants as fertility improvements but migrants invested less in legumes on rented plots. Some similarities occurred between the two groups. Investments in farm manure and mulch reduced when they had enough off-farm earnings. Also those with enough livestock wealth tend to invest less in mulch. Simulations also confirm the importance of income levels of the migrants on the probability to invest in land improvement methods as the model predicts higher probabilities for off-farm earnings.

Chapter 9

Conclusions from the Study

9.1. Summary of Findings

An attempt has been made in this study to explore migration from rural areas of the Upper East Region to the rural areas of the Brong Ahafo Region and its implication for income generation and the quality of the environment. The study is relevant because previous migration studies in Ghana have concentrated on rural-urban migration and international migration. Moreover, these previous studies did not pay much attention to the role of migrants in food crop production at the place of migrant destination but focused mainly on income generation by migrant cocoa farmers in Southern and Western Ghana. Also, theoretical and empirical analyses on rural-rural migration and its effect on the quality of the environment have received minimal attention in the literature, and so the present study expands and challenges our understanding of the issues raised by previous studies.

A number of research issues were therefore raised in this study. In particular, land acquisition became a big issue because income generation of settler farmers from farm work depends very much on the prevailing land tenure arrangements between tenants and indigenous landowners. Specifically, I wanted to address the following questions: how much land area is cultivated under fixed-rent and sharecropping contracts in the Techiman and Nkoranza Districts of Brong Ahafo and what are the effects of the determinants of these? How much is earned from on-farm and off-farm work? What agricultural technology is employed by the households in on-farm income generation? What are the effects of the determinants of off-farm work participation? What are the determinants of migrant remittances to the home area? What short-term investments do migrants undertake in maintaining the fertility of rented plots?

How the farm household survey data employed in the study were collected has been detailed. Focus group discussions and informal interviews were held purposely to capture the livelihood strategies of Upper East migrant farm households in the Brong Ahafo Region. The responses from the focus group discussions and informal interviews provided background information on specific questions to include in the questionnaires so that the study's objectives of assessing how the migrants have settled, how they accessed land for farming, their off-farm income generation, remittances to the home area, and the implications of their agricultural activities on the quality of the environment could be achieved.

Chapter 3 discusses the agro-ecology of the Upper East Region and the Brong Ahafo Region and agricultural activities in the two regions. The order of migration and migration dynamics from Upper East to Brong Ahafo has also been described. Whilst the Upper East experiences warm, and dry, dusty harmattan air mass and monsoon air mass, Brong Ahafo has more moderate temperatures. Brong Ahafo has both the savannah and forest vegetations but in the Upper East, only the savannah vegetation exists with soils whose productivities have declined due to high temperatures and unfavourable moisture regime. Compared to the forest soils in Brong Ahafo, the soils in the Upper East are characterised by rapid soil decomposition rates, and lower organic matter and nutrient status. The Upper East Region has a unimodal rainfall but the Brong Ahafo Region has bimodal annual rainfall.

The annual bimodal rainfall in Brong Ahafo supports two cropping seasons and about 70 percent of the population is engaged in agriculture. The main food crops cultivated are maize, yam, cassava and plantain. Cassava and maize are grown all over the Brong Ahafo Region. The Brong Ahafo Region is the third largest producer of cocoa after the Western Region and the Ashanti Region in Ghana. The main livestock from the region are goats, cattle and poultry. In the Upper East, only one cropping season exists because of the unimodal rainfall pattern. Agriculture in the Upper East Region is mostly mixed farming. Food crops are mostly planted on compound farms, intermediate and bush farms. Major food crops grown in the region are rice, maize, soybeans, sorghum, millet and groundnut. Cotton has also become one of the major cash crops grown in the region. Cattle, goats and sheep are some of the livestock kept in the Upper East Region.

The Chapter points out that since 1960 to 2000, the population of Techiman and Nkoranza have seen consistent increases due to the influx of settler farmers from Northern Ghana. The main ethnic groups involved in the rural-rural migration flow from the Upper East Region to the Brong Ahafo Region are the Frafras from Bolgatanga and the Bongo Districts, the Busangas from the Bawku-East District, the Kasenas from the Kasena-Nankani District, the Kusasis from the Bawku-East and Bawku-West Districts and the Builsas from the Builsa District. In addition to the Namnam Frafras who are the most dominant Upper East ethnic group and were the first to settle in Techiman and Nkoranza Districts, the Busangas were also among the early settlers. Apart from very old settlers who arrived between 1960 and 1979, the study found few recent arrivals. Most of the Upper East migrant farm households in Brong Ahafo therefore started arriving in Nkoranza and Techiman from 1980 to 1999. The mean male-female ratio of the surveyed localities in Brong Ahafo was about 1.13. The highest male-female ratio of about 1.6 occurred at Woraso in the Techiman District and the lowest ratio of 0.94 occurred at Nkwaeso also in the Techiman District. In addition to the most cited phenomena such as availability of good quality land for farming and the presence of commercial activities in Brong Ahafo Region, other potential pull factors contributing to the rural-rural migration

flow include the closeness of Upper East to Brong Ahafo and the easy flow of information and goods between the two regions.

Chapter 4 was entirely devoted to how Upper East migrant farm households acquired land for farming in Brong Ahafo Region. The land rental market is an institution of major and increasing importance in Brong Ahafo and the different tenure arrangements serve as economic incentives for migrant farm households to generate on-farm income from rented land. The study found coexistence of wage contract (owner-cultivation) and rent-contracts (fixed-rent and sharecropping) in Brong Ahafo Region of Ghana. This is an important finding which departs from tenancy arrangements within the cocoa industry in Brong Ahafo or other forest regions in Ghana where sharecropping contracts were found to be the predominant tenure arrangement between tenants and owners. It is also unique from other tenancy arrangements studied in most parts of Southeast Asia where sole-renting regimes appeared to be prevalent. Observations on tenant's plots also revealed relative differences in labour inputs and yields. This may be attributed to farm household characteristics such as initial endowments, tenure status and farm characteristics that affect the farm household's utility. Input use and yields were higher on fixed-rent plots and owner-cultivated plots than cropshare plots but these differences must be viewed from the Marshallian disincentive perspective.

In contrast with other empirical studies, no significant relationships were found between length of stay at the migrant place of destination and acreages under fixed-rent contract or sharecropping contract. A similar finding was also observed for the managerial ability of the farmer in this study. Due to the absence of perfect markets, migrant farm households are often faced with liquidity and institutionally imposed constraints such as lack of credit and insurance in accessing land. The empirical investigations reveal the importance of liquidity constraints on acreage decisions of migrant tenants. In particular, people with more wealth rent more land under fixed rent contracts but there is no clear pattern for sharecropping contracts. It cannot be concluded that sharecropping is an inferior choice that no farmer would ever rent if he had the liquidity needed for a fixed rent contract because we do observe with the Ghanaian data, households who operate land simultaneously under both rental regimes. The simulated results also confirm some of the empirical results. In particular, increasing the tenant's off-farm income from the 10^{th} to 90^{th} percentile of the distribution leads to an increase of 1.27 units in fixed-rent acreages and a decrease of 1.30 units in cropshare acreages. The results were also consistent with the hypothesis that tenants tend to increase sharecropped acreages when wages to hired farm labour decrease, however, this may not be plausible for the area under fixed-rent contracts.

In **Chapter 5** it was noted that on-farm income generation from rented land was one of the primary aims of Upper East migrant farm households in Brong Ahafo. The households were able to raise their income levels by growing food crops such as maize, yam, cassava, beans, groundnuts, onions and tomatoes during the major and

minor seasons. In terms of food crop production, there were not much difference between crops grown by migrants and those of indigenous landowners. The proportion of beans, groundnuts, onion and tomato plots sharecropped was lower than those grown under fixed-rent contracts. Similarly, maize and yam were cultivated on fixed-rent plots rather than on sharecropped plots because of their relative importance to the migrant farm households in terms of labour and capital inputs. Apart from food crops, owner-cultivators planted trees like teak, cashew, and oil palm but only migrant households with taungya plots could undertake tree planting. The mean income from on-farm work was ¢3,586,543 (US$334). The mean gross income per acre was about ¢655,000 (US$77) for maize growers and ¢3,344,000 (US$393) for onion growers. The attractiveness of growing a particular crop however depended on the economic return of the crop to the farm households. The relative profitability of staples like maize and yam in particular were improved when they were combined with other crops such as plantain in intercrop mixtures. In terms of family labour days however, not much difference was observed in the net returns from growing single crops or intercrop mixtures.

Efficient resource allocation is required to stimulate better production systems necessary to generate on-farm income needed by the households. Hence, the farm household's demand for hired labour was analyzed. Instead of the usual probit of participation estimation procedure employed in most empirical studies, the present study employed the actual hours of work by hired hands in an instrumental variable approach where off-farm wage rate and livestock wealth were considered endogenous. Demand for hired farm labour was found to be influenced by farm characteristics and households with sharecropped plots tended to depend less on hired farm labour. There was an inverse relationship between hired farm labour and wages to hired farm labour. The empirical results also indicate a significant positive influence of duration of stay on the amount of hired farm labour demanded by the households. This empirical finding lends credence to our earlier assertion that duration of stay is linked to the household's ability to accumulate enough cash necessary for the financing of farm activities such as the hiring-in of farm labour.

We have also investigated the production relationships of the households with a value-added production function specified in a Cobb-Douglas functional form. This approach provided robust estimates because of the high incidence of zero observations in variable purchased inputs. The empirical results clearly indicated that rented land, farm labour (family and hired) and livestock wealth were relatively important in the agricultural production of Upper East migrant farm households in the Brong Ahafo Region of Ghana. Statistically, land input was associated with higher levels of agricultural output and a one percent increase in farm labour hours corresponded to about 0.53 percent increase in value-added output.

Chapter 6 has investigated off-farm income generation of Upper East migrant farm households in Brong Ahafo. The market participation by husbands was 61 percent and 42 percent for wives. The main sources of off-farm earnings for the

households were wage employment and self-employment activities. The mean earnings from off-farm work was ¢2,840,976 (US$422). Of the total off-farm earnings, 70 percent constitute self-employment income whereas agricultural and non-agricultural wage employment comprise of 9 percent and 21 percent respectively. This then raised a number of questions such as what determines the probability to participate in off-farm work and the extent of off-farm work participation. To answer these questions, the participation decisions, wage determination equations and self-employment return functions of husbands and wives were investigated. The empirical results reveal important findings. For example, self-employment participation by wives decreases as age increases. Migrant wives increased their self-employment participation by a margin of about 0.34 when their education is increased by 1 percent. The influence of length of stay on self-employment participation by men and women was found to be significantly positive, Migrant husbands from sharecropping households tend to engage less in self-employment activities but increase their wage employment participation. What this finding suggests is that sharecropping households which more often than not have liquidity problems find it difficult to enter into self-employment jobs but increase their wage employment participation in order to solve the cash flow problems of the household. However the probability of migrant wives getting self-employed was not influenced by whether or not their husbands had plots under sharecropping contracts. This result is not surprising as the start-up capital for wives in self-employment in most households was supplied by the husbands. These empirical findings are unique in a sense that previous empirical studies have not paid much attention to the importance of tenure differences on the household's leisure. Wage employment participation by men increase at the younger age but decrease during old age. The impact of land on wage employment participation lends support to the hypothesis that migrant tenants with less cultivated land tend to prefer wage contracts by working as casual farm labourers in other people's farms. The age variable which proxied for experience of an individual in the household concurs with the human capital theory. In particular, a one percent increase in the husband's age increases his employment wage by nine percent.

Given that the farm households had a choice between on-farm and off-farm work, the labour supply response of husbands and wives was examined. To capture the effect of a spouse's labour supply response on the other, we introduced the employment wage or hourly returns of the spouse as a separate regressor in the labour supply function of each other, an approach which departs from previous empirical studies and also ensured robust estimation. The farm wage variable exhibited an upward sloping labour supply for husbands. Moreover, the wife's on-farm labour supply is sensitive to the husband's hourly returns from self-employment. The time allocations of husbands and wives increase on-farm when family size increases. The farm wage variable is directly related to the wage employment hours of husbands indicating that men increase their labour time in other people's farm as casual labourers when wage rates to hired farm labour increase. Whilst own wage effects of

couples indicate a backward bending labour supply, the effects of hourly self-employment returns of couples suggest an upward sloping labour supply function.

Chapter 7 looks at migrants from rural areas of Ghana who are remitting to other rural areas. Investigating rural-rural remittances is a priori interesting and potentially makes a greater contribution than the infra-marginal study on international remittances and urban-rural remittances. Evidence from the farm household data revealed that remittance flows were not unidirectional because of the mutual-supporting role between the origin and destination households. However, remittances to the home area were skewed towards the husband's family. The mean annual remittance to the husband's family in the home area was ¢500,655 (US$59) while on average the annual remittances from the destination households to the wife's family were ¢194,333 (US$23). The determinants of remittances from the rural migrants to the home area were investigated and further quantified with simulations. One of the main claims to originality in this study relates to the investigation of the potentially diverging patterns of remittances to the husband's and wife's families in the home area. The empirical results show that remittances to the wife's family are influenced by earnings from on-farm and off-farm employments whilst this finding may not be true for remittances to the husband's family. This empirical finding clearly indicates how remittances are affected by the spouses' bargaining power. The results also show an inverted U-shaped relationship between the age of the household head and the annual remittance to the wife's family in the home area. This is an important empirical finding of life-cycle effect on remittance which indicates that remittances increase at the younger age but decreases with age.

Apart from earnings and age, remittance flows from the destination migrants were influenced by factors which linked the out-migrants to the home area such as informal agreements and inheritance claims. In particular, households with high incidence of informal agreements increased annual remittances to the husband's family while those with inheritance claims increased the amount remitted to the wife's family. The finding that existence of inheritance claims increase remittances reflects the bargaining power of the receiving household when setting the terms of the informal agreement before migration occurs. The statistical results were also supported by simulations as the amount of earnings remitted to the husband's family was found to be higher when earnings from on-farm work and off-farm employments increase. The amount of earnings remitted to the wife's family however depended on age rather than earnings.

Chapter 8 has examined the implications of the agricultural activities of Upper East migrant farm households on the quality of the environment in the Brong Ahafo Region. The differences between the migrants and indigenous landowners regarding environmental improvement have also been highlighted. Despite lack of incentives to undertake long-term investments on plots which have been rented on temporarily basis, migrant tenants made some effort to invest in short-term land improvements on rented plots. In terms of short-term land improvement methods, much difference was

not found between what migrants and indigenous landowners do. However, indigenous landowners could undertake long-term investments by planting trees such as teak, cashew, oil palm and mango. Only migrants with access to taungya plots (which enabled them to undertake food crop production freely in a designated forest reserve) could participate in forestry intervention programs where trees such as teak and cashew were planted as a means of improving the forest vegetation in the Brong Ahafo Region. Very few of them sharecropped mango and oil palm with indigenous landowners. In addition to the tree planting, owners employed the traditional bush fallow system, an improvement method which migrants could not do irrespective of the fallow period because of the disincentive such as tenure insecurity associated with plots which have been rented on short term basis. Some of the prospects for migrants include long-term tenure arrangements between them and owners where trees could be sharecropped and the possibility of re-entering into new contract terms that ensures continuity of producing crops which improve the relative income positions of the migrants.

In this Chapter, I tested whether tenure differences play any role in investments of migrants in land improvements and also whether the differences in income levels of migrants and owners affect their propensity to undertake short-term or long-term investments. The empirical results were robust as the endogeneity of off-farm earnings, livestock wealth and the amount of land cultivated under tenancy contracts were accounted for. The results revealed that migrants with fixed-rent plots use more fertilizer but undertake less investment in legumes and farm manure. Sharecroppers on the other hand, employ more farm manure, fertilizer and mulch as fertility improvements but undertake less investment in trees.

The empirical results showed very few differences in the effect of income levels of migrants and owners on the probability to invest in land improvement methods. For instance, while migrants with higher off-farm earnings have higher probability to invest in trees, the opposite is the case for indigenous owner-cultivators. Moreover, owners with enough liquid wealth tend to employ more leguminous plants as fertility improvement but migrants invested less in legumes on rented plots. Some similarities occurred between the two groups. Investments in farm manure and mulch reduced when they had enough off-farm earnings. Also those with enough livestock wealth tend to invest less in mulch. Simulations also confirm the importance of income levels of the migrants on the probability to invest in land improvement methods as the model predicts higher probabilities for off-farm earnings.

9.2. Conclusions

The impacts of rural-rural migration in the destination areas of Brong Ahafo have been assessed. In the short-term, migrants generated income through initial felling of trees, put more land into intensive use, and applied techniques on rented land

depending on their initial capital endowments and other household characteristics. The co-existence of fixed-rent and sharecropping contracts in Brong Ahafo also provided an economic incentive for the migrant tenants to better their relative income positions through food crop production. The migrants alone did not gain from these tenancy arrangements but the indigenous landowners as well as capital constrained landowners generated additional income by entering into tenancy arrangements with capital holding tenants from the Upper East. The migration is thus a 'win' for Brong Ahafo and the migrants themselves.

In addition to on-farm work, migrants could earn from non-farm sources of employment such as wage employment and self-employment businesses, but this choice is influenced by the human capital endowments of the migrant households and the returns from employment activities. Migrants who earned enough from on-farm and off-farm employments improved the lives of their children and relatives in the home region through remittance money meant purposely for education and the purchasing of food during consumption shortfalls. The sending areas nevertheless benefit immensely from the migration income if remittances are invested in the family farm, put up buildings to provide shelter for the family and develop small-scale micro-enterprises with the remittance money.

Tenure differences of migrants play a critical role in their land improvement activities while income levels of migrants and indigenous owner-cultivators as well affected the land improvement of those two groups. Apart from investing in short-term land improvements on rented plots by the migrant farm households, the environmental implications of the rural-rural migration on the destination areas are felt in the longer term. For instance, migrants could be expected to follow the examples of the indigenous population and adjust their technologies by planting new trees or maintaining the quality of plots through the bush fallow system.

9.3. Policy Recommendations

Land rental markets are effective entry points for the landless to access land for farming. This study has shown that tenure differences affect the land improvement method migrants invest on rented plots. Moreover, the income levels of migrants and owners have implications on their land improvement activities. It was also noted in the study that the better plots which had the tendency to raise the relative income positions of the migrant tenants were rented under fixed-rent contracts and that not all the migrant farm households could access fixed-rent plots due to liquidity constraints and only those that earned income from off-farm employment could increase the area under fixed-rent contracts. These scenarios have welfare and policy implications. First, policies such as designing a better institutional framework for land tenure arrangements should be promoted. Such policy instruments include: 1) strengthening individual rights through long-term investments such as tree planting and

management; 2) strengthening individual rights through inter-vivo transfer of land as gifts and grants; 3) enforcing the Intestate Succession Law (PNDC 111), a legal framework promulgated in 1983 that provides equal rights of inheritance between spouses and increased rights for children instead of bequeathing all the deceased's inheritance to only relatives and other family members; 4) increasing the bargaining power of tenants in sharecropping contracts and increasing their ability to shift from sharecropping to fixed-rent contracts. This can be achieved through provision of legal documents that ensure enforcement of contracts; improving tenants' access to credit and risk coping instruments; 5) facilitating enforcement of well defined contracts which specify the duration of the contract, and clearly states clauses that make room for compensation in case of forcible ejection or termination of contract; 6) promoting the land sale market in Brong Ahafo as a way of distributing land from indigenous landowners to recent arrivals or earlier migrants who have managerial abilities or are endowed with abundant labour resources.

Second, the provision of farmer credit and inputs that facilitate easy entry into both farm work and off-farm work without natural resource degradation should be pursued. To absorb the labour increases in the rural areas where these out-migrants originated, policy makers should aim at developing policies such as provision of accessible roads, electricity, drinkable water and schools which improve the rural infrastructure and create a conducive environment for the development of rural micro-enterprises while increasing returns to human capital investment. Enhancing farmers' efficiency and skills through effective extension delivery is at least one of the policy options that can minimize the negative effects of migrant agricultural production on the quality of the environment. Replicating profitable agro forestry systems like the Taungya system in the Techiman District in other areas of the region will go a long way to reduce rural poverty. Apart from the incentives it provides by allowing the landless to have additional plots for food crop production, improved technologies that makes the agro forestry attractive and profitable such as making tree nurseries accessible and affordable must be developed. Also the development of improved species, especially rapidly growing commercial trees must be pursued. Together with the Ministry of Agriculture and the Ministry of Lands and Forestry, other stakeholders like environmental NGOs should step up the crusade against wild and bush fires so that the natural forest vegetation is preserved. These policies when implemented by the relevant local and governmental agencies could assist in the rural development of both the sending areas in the Upper East Region and the receiving areas in the Brong Ahafo Region of Ghana.

9.4. Suggestions for Future Research

This study has generated some important issues for further research. The first issue concerns the land tenancy agreements between tenants and owners in Techiman and Nkoranza. For instance, it would be nice to conduct further study in which matching

data for migrant tenants and their real owners would be collected. This would enable us to analyse the transaction costs involved in the tenancy contracts. It will also assist us to better capture the contributions by both tenants and owners in maintaining the fertility on rented and owner-cultivated plots. Environmental implications on rented plots could also be properly analysed if the cross-sectional data are developed into panel data. With repeated observations per household or plot, we can control for fixed and random individual, household or plot-level effects or differences.

The second issue requiring further research is the role of migrant tenants in forest intervention programs such as the taungya system. The information provided by the study on this forest management program is somehow limited. For instance, the questions that need to be asked are: What criteria are required for entering into taungya? How long is the tenure on such forest plot? What is the crop choice under the taungya system? What is the role of gender in the intervention programs? I hope to return to these pertinent questions in future research

The third issue concerns the presence of credit market imperfections in the study area. If indeed this is true, then there might be some informal loan agreements between tenants and owners or between local money lenders and tenants to be repaid with flexible interest either in cash or in kind or possibly grants from some local NGOs or credit institutions which enabled poor migrant tenants to access rented plots or finance other farming activities. Also the terms of payment regarding fixed-rent in kind or default payment in sharecropping or contract enforcement in sharecropping and how they affect the acreage decisions of migrant tenants need further investigation.

The fourth issue is risk. Risks issues were not taken into account in the theoretical model on area cultivated under tenancy contracts. We also ignored risk in the analysis of crop choice. These concerns were not given much attention in the study and therefore need to be revisited in future research.

The fifth issue concerns the use of remittances as an informal insurance device within the migrant farm households. Apart from these, the long-term strategy for reducing rural poverty in the home area is to invest part of the remittances in the family farm. This study could not investigate these pertinent issues because of data limitations. To be able to analyse them, one would need matching data on both the origin and the destination households. Future studies should explore this possibility.

Samenvatting (Summary in Dutch)

De gevolgen voor inkomen en milieu van migratie naar landelijke gebieden in Ghana

In deze studie onderzoeken we de migratie van het Noordoosten van Ghana (Upper-East Region) naar de meer centraal gelegen regio Brong-Ahafo. We richten ons op migratie naar rurale gebieden en kijken naar de gevolgen voor inkomens en milieu. Daardoor kunnen we iets toevoegen aan de bestaande literatuur die vooral gericht is op de stroom migranten naar urbane gebieden of het buitenland. Waar migratie naar rurale gebieden wel onderwerp van onderzoek was, betreft het veelal de trek naar de cacaoregio's in het Zuiden en Westen van Ghana.

Een belangrijke vraag die aan de orde komt, is de toegang tot landbouwgrond. Inkomensverwerving van migranten hangt sterk af van de geldende regelingen tussen landeigenaren en de migrant-pachters en het is dus belangrijk om een antwoord te vinden op vragen als hoeveel land er tegen vaste pacht wordt verkregen en hoeveel in deelpacht. Wat bepaalt dit onderscheid? Welke consequenties heeft dit? Een volgende vraag is hoe de tijd van de migranten wordt verdeeld tussen landbouw en niet-landbouw werkzaamheden en wat de bepalende factoren hiervan zijn. Een bijzonder kenmerk van migranten is voorts dat zij banden blijven onderhouden met de familie in het gebied van herkomst. De geldzendingen daarheen zijn ook voorwerp van studie en completeren zo het beeld van de inkomensmogelijkheden die deze migranten hebben. Tenslotte gaan we in op de gevolgen voor het milieu ter plaatse. Is hun vorm van landbouw duurzaam?

De gegevens voor het onderzoek zijn in 2003 verzameld in de districten Techiman en Nkoranza. Het eerste district ligt bij de belangrijke marktplaats Techiman, het tweede ligt meer geïsoleerd. Beide districten zijn belangrijke bestemmingen voor migranten uit de Upper-East Region (UER). In elk district zijn vier dorpen gekozen en in ieder dorp is een willekeurige keuze gemaakt van – in principe – 25 huishoudens van migranten uit de UER. Daarnaast zijn 75 huishoudens van autochtone landeigenaars ondervraagd. Aan de selectie van dorpen, en de opstelling van de vragenlijsten zijn groepsgesprekken in de dorpen voorafgegaan.

Brong-Ahafo Region (BAR) onderscheidt zich van de UER door bimodale regenval die twee oogsten per jaar mogelijk maakt, tegen slechts een oogst in het Noordoosten. BAR heeft ook wat gematigder temperaturen, het bevindt zich in het overgangsgebied tussen tropische bossen en savannes. De grond is relatief vruchtbaar en het leent zich dan ook beter voor landbouw dan de UER. Vele decennia lang is er sprake van migratie vanuit het Noorden (waartoe UER behoort) naar het Zuiden. De eerste migranten die zich vanuit UER in BAR vestigden behoorden vooral tot de Frafra's en Busanga's. De eerste etnische groep komt uit de regio van Bolgatanga, in het Westen van de UER, en de laatste uit het Oosten ervan, de buurt van Bawku. Dertien procent van de ondervraagde

migranten arriveerden voor 1980 en bijna 80% tussen 1980 en 2000. Meestal komt een (jonge) man eerst en volgen later zijn eventuele vrouw en kinderen. In veel vestigingsplaatsen is dan ook de man/vrouw verhouding boven de een, gemiddelde is zij 1,13. Redenen om uit UER weg te trekken zijn de lage bodemvruchtbaarheid (door ruim een derde van de migranten genoemd), gebrek aan land (17%) en gebrek aan andere werkgelegenheid (33%). Desgevraagd meldden de migranten dat de Brong-Ahafo regio hen aantrok wegens de geschiktheid voor landbouw (66%); nabijheid van de herkomstregio (12%) en mogelijkheden voor commercie (4%), naast redenen als de aanwezigheid van familieleden. Techiman in het bijzonder is aantrekkelijk voor commercie en werkgelegenheid. De reële minimum lonen (in termen van maïs) liggen er zo'n 20% hoger dan in Bolgatanga in UER. De census van 2000 laat zien dat de bevolking in Techiman met liefst 94% is gestegen sinds 1984, vergeleken met 36% in Nkoranza en maar 19% in UER, bij een gemiddelde voor Ghana van 54%.

Hoofdstuk 4 van de studie bevat een analyse van de toegang tot land. Het is opvallend dat waar in het Zuiden van Ghana deelpacht de belangrijkste vorm van contract is waarbij de arbeid van de pachter wordt gekoppeld met land van de eigenaar, in de BAR naast deelpacht ook veel vaste-pachtcontracten voorkomen. Bovendien is er 'gewone' inschakeling van arbeid tegen loon. Op percelen die in deelpacht worden gebruikt zijn de inzet van middelen en de opbrengsten lager in overeenstemming met Marshall's inefficiëntie van deelpacht. Pacht tegen vaste prijs vergt echter meestal betaling vooraf en huishoudens met weinig (toegang tot) cash kiezen dan eerder voor deelpacht. Een mogelijk gevolg hiervan is dat de beste stukken land (bijvoorbeeld op bosgrond) vaker tegen vaste prijs worden verhuurd dan in deelpacht. Huishoudens met commerciële activiteiten of meer vermogen kunnen hierdoor vaker voor een vaste pachtprijs en daarmee voor de betere grond kiezen.

Een uitgebreid theoretisch model bevestigt deze samenhang en geeft bovendien de samenhang aan tussen de heersende loonvoet en prijzen en de voorkeur voor een van beide contractvormen. De empirische resultaten zijn verkregen door Tobit regressies toe te passen, waarbij de hoeveelheid land onder elk contract wordt gerelateerd aan mogelijke determinanten. Hierbij hebben we gecorrigeerd voor de mogelijke endogeniteit van enkele variabelen, zoals rijkdom en inkomsten van buiten het bedrijf; bovendien houden we rekening met de ondergrens van nul voor de arealen.

De resultaten laten duidelijk zien dat in gebieden met hoger loon, eerder voor vaste pachtprijs wordt gekozen en dat huishoudens met meer rijkdom daar ook eerder voor kiezen. De overige variabelen, zoals leeftijd en duur van het verblijf in BAR laten geen duidelijk verband zien. Deze uitkomsten wijzen er op dat recente migranten meestal aangewezen zijn op deelpacht en percelen met lagere opbrengsten, namelijk voorzover zij niet beschikken over cash. Oudere migranten promoveren geleidelijk aan naar betere grond tegen een vaste pacht, naarmate zij wel het ervoor benodigde cash hebben. In de theorie zouden oudere migranten, vanwege hun betere reputatie bij de verpachters, juist eerder in aanmerking komen voor deelpacht.

Voor het land dat zij hebben gepacht worden gewassen gekozen, die zowel voor de eigen voedselvoorziening dienen als voor de verkoop. Van het belangrijkste voedselgewas, maïs, wordt meer dan de helft verkocht (52%), maar met grote verschillen tussen Techiman (75) en Nkoranza (33). Bij de verbouw van de gewassen wordt familiearbeid gebruikt, maar nog meer ingehuurde arbeid. De landbouw is dus in aanzienlijke mate marktgeoriënteerd. Belangrijkste gewassen zijn, naast maïs, yam, cassave, bonen, pinda's en groenten. Vooral cassave wordt meer onder deelpacht verbouwd; handelsgewassen zoals tomaten en uien juist meer op percelen met een vaste pacht.

De geldopbrengsten van de gewassen laten grote verschillen zien. De netto opbrengst per mandag van het huishouden voor het hoofdgewas maïs is ongeveer 14.000 cedi's, of $1,6, hetgeen hoger is dan het arbeidsloon dat ongeveer 10.000 cedi's of $1,2 bedraagt. Met een gewas als yam, met 24.000 cedi's, of uien en tomaten met meer dan 50.000 cedi's per dag worden echter hogere opbrengsten bereikt. Deze vergen echter wel meer arbeidsinzet en gebruik van overige productiemiddelen, en zij renderen alleen als de transportkosten naar de markt niet hoog zijn.

Het inkomen uit de landbouw per huishouden kon worden becijferd op $334 per jaar. Van het huishouden werken de mannen hiervoor gemiddeld 77 dagen verspreid over beide regenseizoenen en vrouwen 66 dagen. De overige arbeid wordt geleverd door ingehuurde arbeid, bestaande uit 143 dagen van mannelijke arbeidskrachten, en 44 van vrouwen. In **hoofdstuk 5** is een model ontwikkeld ter nadere verklaring van deze grote inzet van ingehuurde arbeid. Op het niveau van het huishouden wordt de vraag naar ingehuurde arbeid gerelateerd aan onder meer het aandeel van het land in deelpacht, leeftijd, opleiding, vergoeding voor uren gewerkt buiten het bedrijf, rijkdom, duur van het verblijf in BAR en de heersende loonvoet. De eerste en laatste blijken statistisch significant te zijn, evenals de duur sinds vestiging. Hoe meer vaste pacht, hoe meer arbeid wordt ingehuurd; hoe hoger de loonvoet, hoe lager de vraag naar ingehuurde arbeid en hoe meer tijd er is verstreken sinds vestiging, hoe meer arbeid er wordt ingehuurd.

De relatie tussen de productiefactoren land en arbeid en de output wordt gelegd door een productiefunctie te schatten. Aan de outputkant werken we met de toegevoegde waarde en aan de inputkant met de inzet van arbeid, land en rijkdom, naast enkele andere karakteristieken van het huishouden en, zoals steeds, dummy variabelen per dorp. Er zijn Cobb-Douglas functie geschat, op basis waarvan de marginale producten van arbeid zijn uit te rekenen. De productie-elasticiteit van arbeid kon worden bepaald op 0,53 en die van land op 0,40. Deze laatste elasticiteit ligt iets boven de normale waarde voor deelpacht die een derde van de oogst toekent aan de landeigenaar. Het marginale product van arbeid komt in de buurt van de 2.000 cedi's per dag en ligt daarmee fors onder het loon van ingehuurde arbeid.

Er wordt dus meer op het eigen bedrijf gewerkt dan het marktloon mogelijk zou maken, hetgeen wijst op aanwezigheid van arbeidskracht die geen andere

besteding heeft. Om hier meer licht op te werpen is in **hoofdstuk 6** gekeken naar de inkomsten van buiten het bedrijf en de aanbodsfuncties van arbeid. Mannen en vrouwen werken veel buiten het bedrijf, meestal in vormen van eigen onderneming, maar ook wel als landarbeiders. In totaal brengt dit per huishouden $422 per jaar binnen, waarvan 70% uit eigen onderneming. De verdeling tussen man, vrouw en overige leden van het huishouden is 56%, 32% en 12%. Uit Tobit schattingen van de kans dat man of vrouw een eigen onderneming of een betaalde baan heeft blijkt dat mannen vooral in de laatste actief zijn wanneer zij deelpachter zijn en weinig land hebben. Als significante determinanten van de participatie door vrouwen zagen we van alleen de leeftijd, vestigingsduur en opleiding positieve en van ontvangen inkomensoverdrachten negatieve effecten op het hebben van een eigen onderneming. Overige effecten, anders dan dummy's voor locatie, bleken niet significant.

De beloningen van de diverse activiteiten tonen nauwelijks een verband met leeftijd; opleiding heeft alleen een – verrassend – negatief effect op de beloning voor zelfstandig werk, zowel bij vrouwen als mannen.

Met gebruikmaking van gesimuleerde beloningen voor diverse activiteiten hebben we vervolgens aanbodsvergelijkingen van arbeid geschat. Hierin zijn als verklarende variabelen niet alleen de 'eigen' lonen per soort activiteit opgenomen maar ook die van de echtgenoot. Verwacht werd dat zodoende reacties kunnen worden gemeten van de verdiencapaciteit van de ene echtgenoot op het aanbod van arbeid door de andere. De resultaten waren echter teleurstellend. Bij de aanbodsfuncties voor zelfstandig werk waren de 'eigen' lonen significant positief. Dit was ook het geval bij het aanbod van werk op het eigen landbouwbedrijf. Naast deze verwachte resultaten waren de overige coëfficiënten echter alle niet significant, zodat geen duidelijke kruiselingse invloed van het loon van mannen en vrouwen kon worden aangetoond, en evenmin een substitutie-effect van de ene activiteit op de andere.

In **hoofdstuk 7** wordt ingegaan op de geldzendingen, waaronder we ook zendingen van voedsel en andere goederen rekenen. Niet alleen zendt de migrant geld naar de familie van de man, maar ook naar die van de vrouw. De bedragen zijn aanzienlijk, $59 en $23 per jaar, respectievelijk. De theorie omtrent deze zendingen geeft verschillende redenen ervoor: puur altruïsme, sociale normen en het onderhouden van familiebanden, sociale zekerheid en risicospreiding, vergoeding voor genoten opleiding en het zekerstellen van een erfenis. Veel migranten (88%) zeggen een soort overeenkomst te hebben gemaakt met hun familie bij hun vertrek en 76% zegt een zekere claim te hebben op een erfenis, meestal land, maar ook vee. Desgevraagd geven de migranten aan dat hun geldzendingen dienen voor voedselaankopen of al bestaan uit voedsel (31%). De volgende belangrijke bestemming is investeringen in vee en gebouwen (25%).

Veel huishoudens (86%) participeren in deze transfers van geld en goederen. In de meeste gevallen gaat het om zendingen naar de familie van de man (77%), maar vaak ook naar die van de vrouw (51%) alsmede naar anderen (31%). Daar

staan ook stromen in de andere richting tegenover. Ongeveer 40% van de migrantenhuishoudens ontvangen geld of goederen van hun familie.

Wanneer we de waarde van de zendingen relateren aan variabelen zoals leeftijd, inkomen, opleiding, rijkdom en het al of niet hebben van een soort overeenkomst hieromtrent of een claim op een erfenis, dan blijkt het volgende. De omvang van de zendingen naar 's mans familie hangt samen met het inkomen, maar de zendingen naar de familie van de vrouw niet. In het eerste geval zijn bovendien rijkdom van belang en het bestaan van een overeenkomst. In het tweede geval spelen opleiding en leeftijd een (positieve) rol. Dit lijkt te bevestigen dat er een vergoeding wordt gegeven voor genoten opleiding, maar eveneens het bestaan van risicospreiding (bij lager inkomen minder afdracht). De rol van een zekere overeenkomst, misschien een voorwaarde voor het vertrek, wordt ook bevestigd.

In **hoofdstuk 8** gaan we na of de migratie uit UER naar BAR gevolgen heeft voor het milieu in BAR. Migratie verlicht de milieudruk op het land in het Noorden en het is nu de vraag of daar niet negatieve gevolgen in BAR tegenover staan. Aangezien bijna alle migranten pachters zijn, gebruiken zij land slechts tijdelijk en is hun vaak verboden bomen te planten. Braaklegging van land is uiteraard meer een zaak voor de eigenaar dan de pachter. Een deel van de migranten participeert in *Taungya* systeem, waarbij zij toegang krijgen tot land in ruil voor het onderhouden van aangeplante bomen tot volwassenheid.

Satellietopnamen in 1990 en 2000 in de buurt van de onderzochte dorpen laten een achteruitgang in het bosareaal zien van ongeveer 10%, maar dit zou eerder de urbanisatie als oorzaak kunnen hebben dan de uitbreiding van het landbouwareaal.

Migranten onderkennen het belang van duurzame productiewijze. Zij geven aan zelf bij te dragen aan duurzaamheid door minder te ploegen, vruchtwisseling toe te passen, organisch materiaal aan te voeren, kunstmest, mest en vlinderbloemigen te gebruiken en erosie tegen te gaan. Zo'n 35% van de landeigenaars laat grond langer dan 3 jaar braak liggen en velen van hen planten bomen of laten hun pachters dit doen. Hier staat tegenover dat bij ingebruikname van de grond bomen gekapt worden.

De mate waarin de verschillende methoden worden toegepast hangt af van de omstandigheden en de gang van zaken op het bedrijf. In het bijzonder blijkt dat wie zich reeds langer heeft gevestigd, meer grondverbeterende methoden (*mulching*, mest) gebruikt dan nieuwkomers.

We zijn in dit proefschrift de gevolgen nagegaan van migratie naar de Brong-Ahafo Region in Ghana. Migranten die net arriveren, komen veelal eerst in aanmerking voor mindere grond, zoals savannegrond. De betere gronden, vooral voormalig bosland, gaan naar oudere migranten die in staat zijn de vaste pacht ervoor te betalen. Jonge migranten pachten ook vaker tegen deelpacht en combineren dit vaker met betaald werk voor anderen. Voor de migranten is

verhuizen uit de Upper-East Region naar Brong-Ahafo aantrekkelijk. Zij gaan er in inkomen op vooruit. De landeigenaren in Brong-Ahafo profiteren er ook van: zij kunnen nu meer grond verpachten.

Een belangrijk deel van hun inkomen verdienen de migranten buiten het bedrijf, vooral uit zelfstandig werk. Voor hun landbouwwerkzaamheden huren zij ook veel arbeid in. Zo leveren zij ook een bijdrage aan de lokale economie. Hogere inkomens van migranten leiden ook tot hogere bedragen die worden teruggestuurd naar de families in het Noorden, zowel aan de mannelijke als aan de vrouwelijke kant. Zo profiteren de families in het Noorden ook mee van voorspoed in het bestemmingsgebied. Het plaatselijke milieu lijdt er onder doordat het bosareaal afneemt. De landbouwmethoden die de migranten gebruiken zijn echter wel vaak gericht op het behoud van vruchtbaarheid. Hun zeggenschap over lange-termijn vruchtbaarheid, zoals bereikt door braaklegging bijvoorbeeld, is echter gering, omdat hier de eigenaar over gaat. Dit gaat ook op voor aanplant van bomen. Hier ligt een belangrijk terrein voor nader onderzoek en beleid. Het reeds toegepaste *Taungya* systeem lijkt een goede manier om aanplant van bomen te combineren met pacht.

Appendices

NWO FARM HOUSEHOLD SURVEY (2003)

Appendix1. Migrant Household Questionnaire

Section 1. Personal History and In-migration

1.1. Personal History

1	Serial number of household head		Husband	Wife
2	Position in household **(A)**			
3	What ethnic group do you belong? **(B)**			
4	Religion			
5	Hometown			
6	District			
7	Age (yrs)			
8	Where born **(C)**			
9	Education level **(D)**			
10	How many dependents are in your parent's household in UE**?			
11	How many adults (>16 yrs) are in your parent's household in UE?			
12	Did you have your own land before you migrated from Upper East?	1= yes, 2=no		
		If yes, what was the size of plot? (acres)		
		If yes, do you still maintain ownership and management of land? (1= yes, 2=no)		
13	Are you entitled to some form of inheritance in Upper East?	1= yes, 2=no		
		If yes, mention the type of inheritance and the size (value) of inheritance		
14	Are you a member of your ethnic association in BA? (1= yes, 2=no)			

* Interview both husband and wife, ** UE: Upper East, *** BA: Brong Ahafo

Code A (Position)
01=husband
02=wife
03=brother
04=sister
05=son
06=daughter
07=other (specify)

Code B (Ethnic Group)
01=Frafra
02=Kusasi
03=Busanga
04=Kasena Nankani
05=Builsa (Kangyaga)
06=Gurunshie (Kasena)
07=other (specify)

Code C (Where Born)
01=this village
02=out of this district
03=my hometown
04=foreign country
05=other (specify)

Code D (Education Level)
01=none
02=primary
03=middle
04=secondary/college
05=adult education
06=other (specify)

1.2. In-migration of Household Head

			Husband	Wife
1	Serial number of household head			
2	Did you arrive in BA as a child?	1 = yes, 2 = no		
		If yes, at what age? (yrs)		
		If no, what year did you first arrive in this village?		
3	Did you arrive in BA first as a seasonal migrant and then settled later as a permanent migrant?	1=yes, 2 =no		
		If yes, how many year (s) were you arriving as a seasonal migrant before you finally settled down as a permanent migrant?		
4	Did you reach some understanding with your relatives (father, mother, wife/husband, uncle etc.) before migrating from your hometown (1=yes, 2=no)			
5	Were you in paid employment in UE before migrating?	1=yes, 2 =no		
		If yes, was it agricultural or non-agricultural employment?		
6	Why did you migrate from the Upper East Region?			
7	Why did you choose to settle in the Brong Ahafo Region?			
8	How do you compare your life in BA now to that in UE?	01=better 02=same 03= worse because my expectations have not been realised. 04=other(specify)		
9	If you are not satisfied with your life in BA, what do you intend to do?	01= return to Upper East Region 02= continue to stay in this village 03= migrate to another village in BA 04= migrate to another region. 05=other (specify)		

* Interview both husband and wife

Section 2. Migrant Household Composition

2.1. Composition of Permanent Resident Members

1	Serial number of household head									
2	Give a brief history of household since you first arrived.									
3	Is any of your permanent members deceased for the last 5 years?	1=yes, 2=no								
		If yes, what year did he/she die?								
4	List and indicate position of all permanent household members residing with you now **(E)**									
5	Age (yrs)									
6	Was he/she born in BA?	1=yes, 2=no								
		If no, what year did he/she arrive?								
7	What job is he/she engaged in now?**(F)**									

Code E (Position)
01=husband
02=wife
03=son

Code F (Job)
01=student/pupil
02=looking after the family farm
03= non-agricultural wage employment

04=daughter
05=brother
06=sister
07=nephew
08=son-in-law
09=daughter-in-law
10=relative's son
11=relative's daughter
12=other (specify)

04=agricultural wage employment
05=self-employed
06=unemployed
07=other (specify)

Code G (Reasons why Absentee Member Left)

01=to visit
02=to attend funeral
03=attend to sick relative
04=no work at destination
05=financial difficulties
06=self-employment

2.2. Non-resident Members

1	Serial number of household head									
2	List and indicate position of absentee household member in the family. **Same as Code (E)**									
3	Age (yrs)									
4	Where is he/she now? **Same as Code (C)**									
5	Why did he/she leave? **(G)**									
6	What job is he/she engaged in now? **Same as (F)**									
7	Does he/she intend returning to BA	1=yes, 2=no								
		If yes, when is he/she coming back?								

2.3. Composition of Seasonal Migrants Residing with Household Head

1	Serial number of household head					
2	List and indicate position of all seasonal migrant(s) who have visited your household in 2003 **Same as Code (E)**					
3	When did he/she arrive in the household?					
4	What job is he/she engaged in? **Same as Code (F)**					
5	If he/she is still here, what is the duration of his/her stay?					
	If he/she has since left, what was the duration of his/her stay with you?					
6	If he/she has since left, does he/she intend coming back to BA? (1=yes, 2=no)					
	If yes, when is he/she returning to BA?					

Section 3. Plot Characteristics

3.1. Current Characteristics of Plots

1	Serial number of household head				
2	Type of Vegetation	Forest		Savanna	
3	Plot number	P01	P02	P03	P04
4	What is the size of plot (acres)				
5	Distance of plot from home (km)				
6	What is the means of transportation to plot (01= walk, 02= bicycle, 03= motor bike, 04= car)?				
7	Type of slope **(H)**				
8	Indicate the expected soil quality by ranking them **(I)**				
9	Have you planted trees on your plot (s)? (1= yes, 2= no)				

10	Area (acres) planted with trees?				
11	What types of trees have you planted? **(J)**				
12	What year did you plant the trees?				
13	What are the most important reasons for planting the tree **(K)**				
14	How were seedlings obtained? **(L)**				
15	How do you maintain the trees? **(M)**				

Code H (Type of Slope)
01=flat
02=mild slope
03=severe slope
04=other (specify)

Code I (Expected Fertility)
01=very fertile
02=fertile
03=not fertile
04=other (specify)

Code J (Type of Trees)
01=teak
02=cashew
03=oil palm
04=mahogany ("odum")
05=orange
06=mango
07=other (specify)

Code K (Reasons for Planting Trees)
01=to check soil erosion
02=to prevent declines in yields of crops
03=part of tenure agreement
04=to earn income
05=to have secure tenure of plot
06=other (specify)

Code L (Source of Seeds)
01=purchased
02=own grown seedlings
03=community tree nursery
04=other (specify)

Code M (Maintenance of Trees)
01=manual weeding
02=pruning
03=use of weedicides
04=establishing fire lines

3.2. Previous Characteristics of Plot

			P01	P02	P03	P04
1	Plot number					
2	What was the nature of vegetation before you started farming on the land? (1=forest, 2= savanna)					
3	How long have you cultivated the plot since acquisition?					
4	Was the plot under fallow before you started using it?	1=yes, 2=no				
		If yes, how long was the plot put to fallow before you started cultivating it?				
		If no, how long has the plot been put to use before you started cultivating it?				
		Crops grown on plot before you started using it? **(N)**				
5	Were there trees on the plot when you started using it?	1=yes, 2=no				
		If yes, what type of trees? **Same as Code (J)**				
6	Have you cut some trees since you started farming on the plot?	1=yes, 2=no				
		If yes, approximately how many trees have you removed from the plot?				

Code N (Crops Grown)
01=maize
02=sorghum
03=millet
04=yams
05=cassava
06=cocoyam
07=pepper
08=tomato
09=okro
10=garden eggs
11=cowpea
12=groundnuts
13=plantain
14=other (specify)

3.3. Economic Characteristics of Plot

1	Plot number			P01	P02	P03	P04
2	What tenure contract exists between you and your landowner? **(O)**						
3	If share cropping, indicate the following detailed agreements	Duration of tenure (years)					
		How are costs of inputs (seeds, fertiliser) shared between you and your landowner? **(P)**					
		Are you prevented by the landowner from planting any particular tree or crop on plot?	1= yes, 2 =no				
			If yes, why the restrictions?				
4	If rented (hired) land, indicate the following detailed agreements	Duration of tenure (years)					
		Amount paid (¢).					
		Are you restricted from planting any particular tree or crop on plot?	1=yes, 2=no				
			If yes, why the restrictions?				

Code O (Tenure Arrangement)
01=sharecropping (abunu)
02=sharecropping (*abusa)*
03=hired (rented)
04=purchased (owned)
05=free (gift)
06=lease (grant) from chief
07=other (specify)

Code P (Share of Costs of Inputs)
01=migrant tenant bear all the cost
02=landowner bear all the cost
03=cost is shared equally
04=migrant tenant pays two-thirds
05=landowner pays two thirds
06=other (specify)

3.4. Present Use of Plots

3.4.1 Crop Cultivation and Yields

1	Serial number of household head						
2	Plot number			P01	P02	P03	P04
3	Crops grown	Major rainy season (2003)	crop 1				
			crop 2				
	Same as Code (O)	Minor rainy season (2003)	crop 1				
			crop 2				
4	Quantity of crop harvested (bags of maize/100 average tubers of yams etc.)*	Major rainy season (2003)	crop 1				
			crop 2				
		Minor rainy season (2003)	crop 1				
			crop 2				
5	Area of crop harvested (acres)	Major rainy season (2003)	crop 1				
			crop 2				
		Minor rainy season (2003)	crop 1				
			crop 2				
6	Have you observed any decline in crop yields since you settled in this village? (1= yes, 2= no)						
	If yes, what do you think are the causes of this problem?						
7	Is there any difference between the crops you grow and that of the landowner?	1=yes, 2=no					
		If yes, mention some of the differences in the farming systems.					
8	Did you receive any technical assistance from an extension officer in 2003?	1=yes, 2=no					
		If yes, how many times have you been attended to by an extension officer?					

* Record only the important crops

3.4.2. Land Preparation

1	Serial number of household head				
2	Plot number	P01	P02	P03	P04
3	Do you slash and burn in land preparation? (1=yes, 2=no)				
3	Mention any other land preparation method you use on your plots?				
4	Do you intercrop or rotate your crops with legumes? (1=yes, 2=no)				
	Mention other farming systems you have been using on plot.				

3.4.3. Input Use

1	Plot number			P01	P02	P03	P04
2	Input use	Major rainy season (2003)	Type of input **(Q)**				
			Amount paid (¢)				
		Minor rainy season (2003)	Type of input **Same as (Q)**				
			Amount paid (¢)				

Code Q (Type of Inputs)

01=fertiliser (NPK 15-15-15)
02=fertiliser (NPK 20-20)
03=urea (sulphate of ammonia)
04=pesticides/fungicides
05=herbicides/weedicides
06=manure
07=compost
08=planting material
09=improved seeds
10=others (specify)

3.4.4. Hired Labour Input

ADULT MALE	Major rainy season (March – July, 2003)									
	Plot number	P01			P02			P03		
	Type of activity	No	Days	Wage	No	Days	Wage	No	Days	Wage
	Land Preparation									
	Sowing									
	Weed Control									
	Harvesting									
	Minor rainy season (Sept. – Nov. , 2003)									
	Type of activity	No	Days	Wage	No	Days	Wage	No	Days	Wage
	Land Preparation									
	Sowing									
	Weed control									
	Harvesting									
ADULT FEMALE	Major rainy season (March – July, 2003)									
	Plot number	P01			P02			P03		
	Type of activity	No	Days	Wage	No	Days	Wage	No	Days	Wage(¢)
	Land Preparation									
	Sowing									
	Weed Control									
	Harvesting									
	Minor rainy season (Sept. – Nov. , 2003)									
	Type of activity	No	Days	Wage	No	Days	Wage	No	Days	Wage
	Land Preparation									
	Sowing									
	Weed control									
	Harvesting									

3.4.5. Family Labour Input

ADULT MALE	Major rainy season (March – July, 2003)						
	Plot number	PO1		P02		P03	
	Type of activity	No	Days	No	Days	No	Days
	Land Preparation						
	Sowing/Planting						
	Weed Control						
	Harvesting						
	Minor rainy season (Sept. – Nov. , 2003)						
	Type of activity	No.	Days	No.	Days	No.	Days
	Land Preparation						
	Sowing/Planting						
	Weed control						
	Harvesting						
ADULT FEMALE	Major rainy season (March – July, 2003)						
	Plot number	P01		P02		P03	
	Type of activity	No	Days	No	Days	No	Days
	Land Preparation						
	Sowing/Planting						
	Weed Control						
	Harvesting						
	Minor rainy season (Sept.– Nov. , 2003)						
	Type of activity	No	Days	No	Days	No	Days
	Land Preparation						
	Sowing/Planting						
	Weed control						
	Harvesting						

3.4.6. Sustainability on Plots

1	Serial number of household head		
2	Type of vegetation	Forest*	Savanna
3	Plot number		
4	Are you aware of any soil conservation method? (1=yes, 0=no)		
5	What erosion control methods do you use in controlling soil erosion on your plot? (terraces, ditches, windbreaks, earth dams, etc.)		
6	What agronomic practices do use on plots? (e.g. multiple cropping, mulching, crop rotation, cover crops, etc.)		
7	What soil management practices do you use on plots? (deep ploughing, compost , farm manure, green manure , fertiliser)		
8	What cultivation practices do use on plot? (e.g. minimum tillage, zero tillage, ridging across slope, ridging along slope, making mounds, etc.)		
9	Are there any differences in the soil erosion control and fertility methods you apply in BA and that in UE? (1=yes, 2=no)		
	If yes, mention the differences		

* Does not apply to Upper East

3.4.7. Future Use of Plot (in five years time)

Plot No.	Mention any future use(s) of plot			
	No. of years you intend using plot	What land preparation techniques would you adopt when the tenure on plot is renewed?	What crops are you going to cultivate in case you decide to renew your tenure on plot?	How are you going to restore fertility on plot when you decide to renew your tenure?
P01				
P02				
P03				
P04				

Section 4. Household Income and Assets (Wealth)

4.1. Household Ownership of Implements/Tools/Assets

1	Serial number of household head				
2	What types of implements/tools do you use in your farm? **(R)**				
	How many of the implements do you have?				
	How did you acquire them? **(S)**				
	What year did you acquire them?				
	What is the cost of the implement?				
	What implements are borrowed? **Same as (R)**				
	Are there any differences in the farm implements/tools you use in BA and that in UE? (1=yes, 2=no)				
	If yes, mention the differences				
3	Which of the following assets do you have? **(T)**				
	How did you acquire them? **Same as (S)**				

Code R (Implements)
01=cutlass
02=hoe
03=axe
04=mattock
05=bullock plough
06=tractor
07=basket
08=sacks
09=head pan
10=other (specify)

Code S (Source of Funds)
01=loan from the bank
02=loan from credit union
03=loan from 'susu' collectors
04=loan from traders
05=loan from money lenders
06=income from crop sales
07=income from non-farm
08=income from livestock sales
09=other (specify)

Code T (Ownership of Assets)
01=cart
02=car
03=motor bicycle
04= bicycle
05= tractor
06= refrigerator
07=television
08=house
09=others (specify)

4.2. Income from Crop Sales

1	Serial number of head							
2	Type of Crop		Maize (bags)	Yam (100 average tubers)	Cassava (bags/ Taxi boot)	Plantain (bunches)	Groundnut/ Beans (bags)	Vegetable* (boxes/ crates)
3	What quantity of the crop was harvested in 2003?	Major rainy season						
		Minor rainy season						
4	What quantity of the crop was sold in 2003?							
	What income (¢) was obtained from those sold in 2003?							
5	What quantity of the crop was stored in 2003?	Major rainy season						
		Minor rainy season						
6	What quantity of the crop did the household consume in 2003?							

* Specify particular vegetable

4.3. Livestock Ownership

1	Serial no. of head						
2	What type of animal do you keep? (tick the appropriate box)	Cattle	sheep	goat	pigs	chicken	guinea fowls
3	What quantity did you have at the beginning of 2003?						
4	What quantity did you have at the end of 2003?						
5	Did a veterinary officer attend to your animals in 2003? (1=yes, 2=no)						

4.4. Marketing of Agricultural Produce

1	Serial no. of head						
2	Type of crop	Maize (bags)	Yam (100 average tubers)	Cassava (bags/ taxi boot)	Plantain (bunches)	Ground nut/ Beans (bags)	Vegetables* (boxes/ crates)
3	How do you sell your farm produce? (market channels)						

4	What are the marketing costs?						
5	What is the value (¢) of the marketing costs?						
6	What are the main problems with marketing of the farm produce?						

*** Specify** which vegetable

4.6. Non-farm Business Activities

1	Serial number of household head*		Husband	Wife
2	Self-employment	Type of business? **(U)**		
		How much time (in hours) is spent on the work each day?		
		How was capital obtained for the business? **Same as Code (S)**		
		What were the costs (¢) of this business in 2003?		
		What was the total income (¢) in 2003?		
3	Non-agricultural wage employment (e.g. drivers, truck pushers, watchman, etc.)	Actual job **(V)**		
		Number of days used for this work		
		Monthly wage (¢)		
		How was payment made? **(W)**		
		Value of payment in kind (¢)		
		Value of payment in cash (¢)		
4	Off-farm agricultural employment (e.g. hired labour etc.)	Actual job. **Same as Code (V)**		
		Daily wage (¢)		
		Number of days used for this work		
		How was payment made? **Same as Code (W)**		
		Value of payment in kind (¢)		
		Value of payment in cash (¢)		

* Interview both husband and wife

Code U (Type of Self-employment)
01=pito brewing
02=handicrafts
03=selling of cooked food
04=shoe shine/repairing
05=charcoal production
06=gari processing
07=table top/market stall
08=general retail shop
09=tailoring/seamstress
10=other (specify)

Code V (Type of Wage employment)
01=employee working for rural private employer
02=employee working for government
03=hired farm labourer
04=exchange work in relative's farm
05=exchange work in friend's farm
06=exchange work in local transport owner's farm
07=other (specify)

Code W (Payment of Wages)
01=cash
02=payment in kind
03=use of plough
04=free transportation to/from farm
05=other (specify).

Section 5. Remittances

5.1. Remittances flow*

1	Serial number of household head			
2	Remittances from migrants to compound household at Upper East Region (Jan 2003 – Dec 2003)	cash remittance(¢)	To Husband's Family	To Wife's Family
		remittance in kind		
		Value of remittance in kind (¢)		
3	Remittances from compound household at Upper East Region to a migrated member in Brong Ahafo Region. (Jan 2003 – Dec 2003)	cash remittance(¢)	From Husband's Family	From Wife's family
		remittance in kind		
		Value of remittance in kind (¢)		
4	Remittances from migrants to relatives living elsewhere other than Upper East Region (Jan 2003 – Dec 2003)	cash remittance(¢)	To Husband's Relative	To Wife's Relative
		remittance in kind		
		Value of remittance in kind (¢)		
5	Remittances from relatives living else where other than Upper East Region to migrant household in Brong Ahafo Region (Jan 2003 – Dec 2003)	cash remittance(¢)	From Husband's Relative	From Wife's Relative
		remittance in kind		
		Value of remittance in kind (¢)		

* Interview both husband and wife of migrant household

5.2. Uses of Remittances*

1	Serial number of household head			
2	Do you instruct your relatives in Upper East on what do with the cash remittances you send to them?	1=yes, 2= no	In Husband's family	In Wife's family
		If yes, what are some of the uses?		
		If no, mention some of the other uses you think your relatives put the cash remittances you send them to.		

* Interview both husband and wife of migrant household

Appendix 2. Owner-cultivated Household Questionnaire

Section 1. Personal History of Landowner

1	Serial number of landowner	
2	What ethnic group do you belong? **(A)**	
3	Age	
4	Sex (1=male, 2=female)	
5	Religion	
6	Hometown	
7	District	
8	Where born **(B)**	
9	Education level **(C)**	
10	Occupation	
11	Number of children	

Code A (Ethnic Group)
01=Brong
02=Asante
03=Fanti
04=other (specify)

Code B (Where Born)
01=this district
02=out of district
03=my hometown
04=foreign country
05= other (specify)

Code C (Education Level)
01=none
02=primary
03=middle
04=secondary/college
05= adult education
06=other (specify)

Section 2. Plot Characteristics

2.1. Plot Ownership

1	Serial number of landowner	
2	How many plots do you own?	
3	How did you become the owner? **(D)**	
4	How many plots have you released to migrants (tenants) this year?	
5	How many plots are you farming this year?	
6	Who inherits the plot (s) when you pass away?	

Code D (Plot Ownership)
01=inherited maternal family
02=inherited paternal family
03=husband family land
04=hired/rented land
05= sharecropping
06= free/gift
07=stool land (lease/grant from chief)
08=personally owned land (purchased)

2.2. Current Characteristics of Plots

1	Serial number of landowner				
2	Type of Vegetation	Forest		Savanna	
3	Plot number	P01	P02	P03	P04
4	What is the size of plot (acres)				
5	Distance of plot from home (km)				

6	What is the means of transportation to plot (01= walk, 02= bicycle, 03= motor bike, 04= car)?				
7	Type of slope **(E)**				
8	Indicate the expected soil quality of plot by ranking them **(F)**				
9	Have you planted trees on your plot? (1= yes, 2= no)				
10	Area (acres) planted with trees?				
11	What types of trees have you planted? **(G)**				
12	What year did you plant the trees?				
13	What are the most important reasons for planting tree **(H)**				
14	How were seedlings obtained? **(I)**				
15	How do you maintain the trees? **(J)**				

Code E (Type of Slope)
01=flat
02=mild slope
03=severe slope
04=other (specify)

Code F (Expected Fertility)
01=very fertile
02=fertile
03=not fertile
04=other (specify)

Code G (Type of Trees)
01=teak
02=cashew
03=oil palm
04=mahogany ("odum")
05= orange
06= mango
07=other (specify)

Code H (Reasons for Planting Trees)
01=to check soil erosion
02=because of declining yields of crop
03=part of tenure agreement
04=to earn income
05=to have secure tenure of plot.
06=other (specify)

Code I (Source of Seedlings)
01=purchased
02=own grown seedlings
03=community tree nursery
04=other (specify)

Code J (Maintenance of Trees)
01=manual weeding
02=pruning
03=use of weedicides
04=establishing firelines
05=other (specify)

2.3. Previous Characteristics of Plot

			P01	P02	P03	P04
1	Plot number					
2	What was the nature of vegetation before you started farming on the land? (1=forest, 2= grassland/savanna)					
3	Have you put any of the plot (s) under fallow since you started using it?	1=yes, 2=no				
		If yes, how long was the plot put to fallow?				
		If no, what are your reasons for not fallowing?				
4	Crops were grown on the plot before you started using it? **(K)**					
5	Were there trees on the land when you started using it?	1=yes, 2=no				
		If yes, what type of trees? **Same as Code (G)**				
6	Have you cut some trees since you started farming on the plot?	1=yes, 2=no				
		If yes, approximately how many trees have you removed from the plot?				

Code K (Crops Grown)
01=maize
08=tomato

02=sorghum
03=millet
04=yams
05=cassava
06=cocoyam
07=pepper
09=okro
10=garden eggs
11=cowpea
12=groundnuts
13=plantain
14=other (specify)

2.4. Economic Characteristics of Plot

1	Plot number			P01	P02	P03	P04
2	What tenure contract exists between you and your tenant? **(L)**						
3	If share cropping, indicate the following detailed agreements	Duration of tenure (years)					
		How are costs of inputs shared between you and your landowner? **(M)**					
		Are you prevented by the landowner from planting any particular tree or crop on plot?	1= yes, 2 =no				
			If yes, why the restrictions?				
4	If rented (hired) land, indicate the following detailed agreements	Duration of tenure (years)					
		Amount paid (¢).					
		Are you restricted from planting any particular tree or crop on plot?	1=yes, 2=no				
			If yes, why the restrictions?				
5	Would you continue to rent out land to tenant migrants?	1=yes, 2=no					
		If yes, what happens to fallow periods on plot and price if more migrant tenants arrive?					

Code L (Tenure Arrangements)
01=sharecropping (abunu)
02=sharecropping (*abusa)*
03=hired (rented)
04=purchased (owned)
05=free (gift)
06=lease (grant) from chief
07=other (specify)

Code M (Share of Cost of Inputs)
01=migrant tenant bear all the cost
02=landowner bear all the cost
03=cost is shared equally
04=migrant pays two-thirds
05=landowner pays two thirds
06=other (specify)

2.5. Present Use of Plots

2.5.1. Crop Cultivation and Yields

1	Serial number of landowner						
2	Plot number			P01	P02	P03	P04
3	Crops grown **Same as Code (K)**	Major rainy season (2003)	crop 1				
			crop 2				
		Minor rainy season (2003)	crop 1				
			crop 2				
4	Quantity of crop harvested (bags of maize/100 average tubers of yams etc.)*	Major rainy season (2003)	crop 1				
			crop 2				
		Minor rainy season (2003)	crop 1				
			crop 2				
5	Area of crop harvested (acres)	Major rainy season (2003)	crop 1				
			crop 2				
		Minor rainy season	crop 1				

		(2003)	crop 2				
6	Have you observed any decline in crop yields since you became owner of this plot? (1= yes, 2= no)						
	If yes, what do you think are the causes of this problem?						
7	Is there any difference between the crops you grow and that of tenants?	1=yes, 2=no					
		If yes, mention some of the differences in the farming systems.					
8	Did you receive any technical assistance from an extension officer in 2003?	1=yes, 2=no					
		If yes, how many times have you attended to by an extension officer?					

* Record only the important crops

2.5.2. Land Preparation

1	Serial number of land owner				
2	Plot number	P01	P02	P03	P04
3	Do you slash and burn during land preparation? (1=yes, 2=no)				
3	Mention any other land preparation method you use on your plots?				
4	Do you intercrop or rotate your crops with legumes? (1=yes, 2=no)				
	Mention other farming systems you have been using on plot.				

2.5.3. Input Use

1	Plot number			P01	P02	P03	P04
2	Input use	Major rainy season (2003)	Type of input **(N)**				
			Amount paid (¢)				
		Minor rainy season (2003)	Type of input **Same as (N)**				
			Amount paid (¢)				

Code N (Type of Inputs)

01=fertiliser (NPK 15-15-15)
02=fertiliser (NPK 20-20)
03=urea (sulphate of ammonia)
04=pesticides/fungicides
05=herbicides/weedicides
06=improved seeds
07=planting materials
08=manure/compost
09=other (specify)

2.5.4. Hired Labour Input

ADULT MALE	Major rainy season (March – July, 2003)									
	Plot number	PO1			P02			P03		
	Type of activity	No	Days	Wage	No	Days	Wage	No	Days	Wage
	Land Preparation									
	Sowing									
	Weed Control									
	Harvesting									
	Minor rainy season (Sept. – Nov. , 2003)									
	Type of activity	No	Days	Wage	No	Days	Wage	No	Days	Wage
	Land Preparation									
	Sowing									
	Weed control									
	Harvesting									
ADUL	Major rainy season (March – July, 2003)									
	Plot number	P01			P02			P03		
	Type of activity	No	Days	Wage (¢)	No	Days	Wage (¢)	No	Days	Wage (¢)

T	Land Preparation									
	Sowing									
F	Weed Control									
E	Harvesting									
M	Minor rainy season (Sept. – Nov. , 2003)									
A	Type of activity	No	Days	Wage	No	Days	Wage	No	Days	Wage
L	Land Preparation									
E	Sowing									
	Weed control									
	Harvesting									

2.5.6. Family Labour Input

	Major rainy season (March – July, 2003)						
	Plot number	PO1		P02		P03	
	Type of activity	No	Days	No	Days	No	Days
A	Land Preparation						
D	Sowing/Planting						
U	Weed Control						
L	Harvesting						
T	Minor rainy season (Sept. – Nov. , 2003)						
	Type of activity	No.	Days	No.	Days	No.	Days
M	Land Preparation						
A	Sowing/Planting						
L	Weed control						
E	Harvesting						
	Major rainy season (March – July, 2003)						
A	Plot number	P01		P02		P03	
D	Type of activity	No	Days	No	Days	No	Days
U	Land Preparation						
L	Sowing/Planting						
T	Weed Control						
	Harvesting						
F	Minor rainy season (Sept.– Nov. , 2003)						
E	Type of activity	No	Days	No	Days	No	Days
M	Land Preparation						
A	Sowing/Planting						
L	Weed control						
E	Harvesting						

2.5.7. Sustainability on Plots

1	Serial number of landowner				
2	Type of vegetation	Forest *		Savanna	
3	Plot number	P01	P02	P03	P04
4	Are you aware of any soil conservation method (1=yes, 2=no)				
5	What erosion control methods do you use in controlling soil erosion on your plot? (terraces, ditches, windbreaks, earth dams, etc.)				
6	What agronomic practices do use on plots? (multiple cropping, mulching, crop rotation, cover cropping, etc.)				

7	What soil management practices do you use on plots? (e.g. deep ploughing, compost and farm manure, green manure, use of fertiliser, etc.)		
8	What cultivation practices do use on plot? (e.g. minimum tillage, zero tillage, ridging across slope, ridging along slope, making mounds etc.)		
9	Are there any differences in the soil erosion control and fertility methods you apply in BA and that in Upper East? (1=yes, 2=no)		
	If yes, mention the differences		

* Does not apply to Upper East

2.5.8. Future Use of Plot

Plot No.	Mention any Future Use (s) of Plot			
	No. of years you intend using or leasing out plot	Land preparation techniques	What crops are you going to grow in five years time and why?	How are you going to restore fertility on the plot in five years time?
P01				
P02				
P03				

Section 3. Income and Assets (Wealth) of Landowner

3.1. Ownership of Implements/Tools/Assets

1	Serial number of land owner					
2	What types of implements/tools do you use in your farm? **(O)**					
	How many of the implements do you have?					
	How did you acquire them? **(P)**					
	What year did you acquire them?					
	What is the cost of the implement?					
	What implements are borrowed? **Same as (O)**					
	Are there any differences in the farm implements/tools you use in B/A and that in Upper East? (1=yes, 2=no)					
	If yes, mention the differences					
3	Which of the following assets do you have? **(Q)**					
	How did you acquire them? **Same as (P)**					

Code O (Implements)
01=cutlass
02=hoe
03=axe
04=mattock
05=bullock plough
06=tractor
07=basket
08=sacks
09=head pan
10=other (specify)

Code P (Source of Funds)
01=loan from the bank
02=loan from credit union
03=loan from 'susu' collectors
04=loan from traders
05=loan from money lenders
06=income from crop sales
07=income from non-farm
08=income from livestock sales
09=other (specify)

Code Q (Ownership of Assets)
01=cart
02=car
03=motor bicycle
06=refrigerator
07=television
08=radio

04=bicycle 09=house
05=tractor 10=others (specify)

3.2. Income from Crop Sales

1	Serial number of landowner							
2	Type of Crop		Maize (bags)	Yam (100 average tubers)	Cassava (bags/ taxi boot)	Plantain (bunches)	Ground nuts/ Beans (bags)	Vegetables* (boxes/ crates)
3	What quantity of the crop was harvested in 2003?	Major rainy season						
		Minor rainy season						
4	What quantity of the crop was sold in 2003?							
	What income (¢) was obtained from those sold in 2003?							
5	What quantity of the crop was stored in 2003?	Major rainy season						
		Minor rainy season						
6	What quantity of the crop did the household consume in 2003?							

* Specify particular vegetable.

3.3. Livestock Ownership

1	Serial number of landowner						
2	What type of animals do you keep? (tick the appropriate box)	cattle	sheep	goats	Pigs	chicken	guinea fowls
3	What quantity did you have at the beginning of 2003?						
4	What quantity did you have at the end of 2003?						
5	Did any veterinary officer attend to your animals in 2003? (1=yes, 2=no)						

* Tick the space below

3.4. Marketing of Agricultural Produce

1	Serial number of landowner						
2	Type of crop	Maize (bags)	Yam (100 average tubers)	Cassa-va (bags/ taxi boot)	Plant-ain (bunches)	Groundnut/ Beans (bags)	Vegeta-bles* (boxes /crates)

3	How do you sell your farm produce? (market channels)						
4	What are the marketing costs?						
5	What is the value (¢) of the marketing costs?						
6	What are the main problems with marketing of the farm produce?						

* Specify which vegetable

3.6. Off-farm Business Activities

1	Serial number of landowner		
2	Self-employment	Type of business? **(R)**	
		How much time (in hours) is spent on the work every day?	
		How was capital obtained for the business? **Same as Code (P)**	
		What were the costs (¢) of this business in 2003?	
		What was the income (¢) from the business in 2003?	
3	Non-agricultural wage employment	Actual job **(S)**	
		Number of days used for this work	
		Monthly wage (in cedi)	
		How was payment made? **(T)**	
		Value of payment in kind (¢)	
		Value of payment in cash (¢)	
4	Off-farm agricultural employment (e.g. hired labour)	Actual job **Same as Code (S)**	
		Daily wage (¢)	
		Number of days used for this work	
		How was payment made? **Same as Code (T)**	
		Value of payment in kind (¢)	
		Value of payment in cash (¢)	

Code R (Type of Self-employment)
01=pito brewing
02=handicrafts
03=selling of cooked food
04=shoe shine/repairing
05=charcoal production
06=gari processing
07=table top/market stall
08=general retail shop
09=tailoring/seamstress
10=other (specify)

Code S (Type of Wage Employment)
01=employee working for rural private employer
02=employee working for government
03=hired farm labourer
04=exchange work in relative's farm
05=exchange work in friend's farm
06=exchange work in local transport owner's farm
07=other (specify)

Code T (Payment of Wages)
01=cash
02=payment in kind
03=use of plough
04=free transportation to/from farm
05=other (specify).

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